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ABSTRACT

Performance in concrete and abstract tasks is examined systematically by varying the degree of abstractness of problem-solving and concept formation tasks. Four forms of a problem solving test were constructed. Each form of the test presented problem situations through four different modes: verbal stories, picture-book, color slides, three-dimension models. Advantaged and disadvantaged children from grades 2 and 4 were randomly assigned to test modes. Similar arrangements were made for testing concept formation. Stimulus material for the concept formation tests were presented via three modes: paper and pencil, motion picture film and actual objects. The degree of concreteness in the mode of presentation does affect the performance of children on the tasks. For only one of the the tasks, however, did the socioeconomic factor exhibit systematic relationships with the factor of concreteness. On the problem-solving task, all children performed best on the more concrete forms. Advantaged children out performed disadvantaged on all forms. On the concept formation tasks, however, the disadvantaged children out performed advantaged children on the most concrete test form. Additional factors which may have influenced test performance are discussed. A substantial reference listing, concept learning tests, and problem-solving tests are included. (Author/RC)

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MEASUREMENT OF CONCEPT FORMATION AND PROBLEM-SOLVING IN DISADVANTAGED ELEMENTARY SCHOOL CHILDREN

Ernest McDaniel, John F. Feldhusen,
Grayson Wheatley, and John C. Houtz

Purdue Research Foundation
West Lafayette, Indiana 47907

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Abstract

Objectives

This research examines performance of concrete vs. abstract tasks by systematically varying the degree of abstractness of problem-solving and concept formation tasks. The relationship of SES to performance on the various tasks is analyzed.

Procedure

Four forms of a problem solving test were constructed. Each form of the test presented problem situations through four different modes, each mode being more concrete than the preceding mode: verbal stories, picture-book, color slides, three-dimensional models. Advantaged and disadvantaged children from grades 2 and 4 of a large urban school system were randomly assigned to test modes.

Similar arrangements were made for testing concept formation. Stimulus material for the concept formation tests were presented via three modes: paper and pencil, motion picture film and actual objects. Again, subjects were randomly assigned to test modes.

Results

The degree of concreteness in the mode of presentation does affect the performance of children on the tasks. For only one of the tasks, however, did the socioeconomic factor exhibit systematic relationships with the factor of concreteness. On the problem-solving task, both advantaged and disadvantaged children performed best on the more concrete forms. Advantaged children out performed disadvantaged on all forms. On the concept formation tasks, however, the disadvantaged children out performed advantaged children on the most concrete test form. Additional factors which may have influenced test performance are discussed.

CHAPTER I

INTRODUCTION

Research with children from lower socio-economic backgrounds and minority ethnic groups has demonstrated that the performance of these children on tests of intelligence and school achievement is below that of their white, middle-class classmates (Osborne, 1960; Kennedy, VanDeReit, & White, 1963; Wilson, 1963; Bloom, 1964; Coleman, et al., 1966). More specifically, investigators have found significant socio-economic and ethnic differences in performance on a number of conceptual and verbalization tasks, such as problem-solving, classification, hypothesis-testing, concept formation, and rule-usage tasks (Siller, 1957; John, 1963; Sigel, Anderson, & Shapiro, 1966; Odom, 1957; Green & Rohwer, 1971; Guthrie, 1971; Stevenson, Williams, & Coleman, 1971).

The explanation most often given for these differences has been described as the "environmental deficit model (Cicirelli, 1972)." This model proposes that children from lower socio-economic backgrounds and minority ethnic groups are "deficient" in certain skills related to successful academic performance, in particular, conceptual thinking skills, because their environments do not provide the number or type of experiences which encourage the development of these skills.

Bernstein (1958, 1959, 1960) and John and Goldstein (1964) have shown that, in terms of language use, in the lower-class home there are more short commands and simple statements, less complex logical relations are expressed, and the symbolism is more descriptive and concrete than in the middle-class home. Hess and Shipman (1965) and Milner (1951) have observed that, in the lower-class home, the control and communication practices of the mother do not reward or encourage the development in the child of the ability to ask questions, examine alternatives, or analyze causes or reasons for actions or events taking place. The effect of these cultural differences in experiences has thus been to "slow-down" the transition of the lower-class child from concrete to more abstract modes of thought (Rothenberg & Courtney, 1969; Wallach, 1963; Ginsburg, 1972; Stodolsky & Lesser, 1967; Wei, Lavatelli, & Jones, 1971; Sharan & Weller, 1971; Almy, Chittenden, & Miller, 1966).

To compensate for this difference, Ausubel (1968) proposed that learning aids for the disadvantaged child be made as concrete as possible. Sigel and McBane (1967) and Securro and Walls (1971) found that lower-class children perform best on a categorization task where objects are used instead of pictures and where realistic versus artificial stimuli are used. They concluded that the concreteness may enable the child to interact more effectively with the materials and the information they provide.

Purpose of the Present Experiments

The present experiments were designed to test the effect of the addition of a greater degree of concreteness and realism to the item format of a test of problem-solving ability and a test of concept formation ability among advantaged and disadvantaged elementary school children. A test of problem-solving ability was developed which makes use of realistic situations involving children and adults (Feldhusen, Houtz, & Ringenbach, 1972). Children are asked to perform a number of different kinds of complex, conceptual tasks: define problems, ask questions about them, select possible causes, suggest alternative solutions, foresee consequences of events, notice critical details, verify solutions, and judge if enough information has been provided to solve the problem. The problem situations are portrayed to children via black and white line drawings in cartoon form. These drawings are presented as slides.

A test of concept formation ability was also developed (Wheatley, 1972) which makes use of classical and Piagetian concept formation problems where the stimuli are presented via a motion-picture film. The classical concept formation problems present abstract shapes and figures and require children to identify the relevant attributes which differentiate one set of figures from another. The Piagetian items present various conservation problems where children must judge if stimuli remain unchanged after an apparent transformation portrayed on film.

Both problem solving and concept formation instruments have a high degree of reliability (.79 for problem solving, .90 for concept formation) and have been found to correlate moderately with each other and with measures of logical thinking, school achievement, and intelligence (Feldhusen, Houtz, & Ringenbach, 197[illegible]).

For the purposes of the present investigation, three additional problem-solving test forms were constructed. Full-color, two- and three-dimensional models were made of the problem scenes portrayed in in the drawings and presented in their place; the pictures themselves were printed in the test answer booklets; and stories were written and substituted in the booklets in place of the pictorial stimuli. The four different test forms were designed to form a continuum (Edling, 1966) from a most abstract (the stories) to a most concrete or realistic (the models) mode of representation of the problem situations. The picture-book and slide presentations were designed to represent intermediate stages. Figure 1 places the four test forms on a continuum based on the cues to realism present in the item formats.

In a similar manner, two additional concept formation test forms were constructed. One new form was designed to be as abstract as possible by drawing the classical concept formation stimuli on pages of a test booklet and eliminating the film altogether. The Piagetian conservation problem stimuli were also represented by series of black and white drawings designed to portray the transformation and placed in a test booklet without the aid of film. The second new form was designed to be as realistic and concrete as possible by presenting all of the item stimuli in the form of the actual objects undergoing a transformation, in the case of the conservation problems, or three-dimensional objects, in place of the abstract figure drawings, in the case of the classical concept formation problems. Figure 2 places each of the three concept formation test forms on a continuum of realism.

Experiments I and II

Two experiments with the problem-solving inventory were conducted. The first experiment involved 410 second and fourth grade children from two schools in Indianapolis, Indiana. The second experiment was designed to replicate the results of the first experiment. Five additional schools in Indianapolis, involving 793 second- and fourth-graders, took part in the second experiment. Disadvantaged children in both experiments were identified on the basis of the criteria used by the Federal Government to determine eligibility of their school for funds allocated under Title I of the Elementary and Secondary Education Act of 1965.

One experiment with the concept formation inventory was conducted. Using the same Federal Criteria for judging degree of disadvantage of children, two additional schools were selected to participate in the concept formation experiment. Three hundred sixty second- and fourth-greaders were involved.

Cues to Realism	Test Forms I. Abstract Stories	 II. Picture-book	 III. Slides	 IV. Models
Words	X	X	X	X
Symbolic, black & white cartoons,		X	X	X
Life-size cartoons			X	
Three dimensionality in the cartoons				X
Full-color in the cartoons				X

Figure 1

Continuum of Realism Created by the Four Problem-Solving Test Forms

Cues to Realism	Test Forms		
	I Paper and Pencil	II Film	III Actual Objects
Words	X	X	X
Pictures (black & white)	X		
Motion		X	X
Color		X	X
Actual objects			
3 -dimensionality			X

Figure 2

Continuum of Realism Created by the Three Concept Formation Test Forms

Hypotheses

It was hypothesized that more realistic presentation of the problem situations would facilitate children's intellectual operations and involvement with the situations, and thus improve performance. Specifically, several experimental hypotheses were generated:

1. Older children will outperform the younger on all forms of the problem-solving and concept formation inventories.
2. Children from disadvantaged backgrounds will obtain lower scores on the two inventories than will children from advantaged backgrounds.
3. White children will outperform non-white children on the two inventories.
4. Disadvantaged children will score highest on the most concrete form of the two inventories; advantaged children's scores on the various forms of each test will not differ significantly.

CHAPTER II

REVIEW OF RELATED RESEARCH

The present experiments rest on three theoretical assumptions. The first is that intellectual development proceeds with age from more concrete to symbolic thought. The second assumption is that the disadvantaged child is retarded in this transition because of inappropriate early environmental experiences, and the third is that the use of concrete aids or more "realistic" materials enhances performance of children on abstract learning or conceptual tasks. The present review considers research which concerns each of these assumptions.

The Development of Intelligence

For Jean Piaget (Flavell, 1963), "actions performed by the subject constitute the substance or raw material of all intellectual and perceptual adaptation (p. 83)." In infancy, these are overt motor actions; the infant sucks on a bottle, grasps a toy rattle, or shakes his arms and legs. As the child develops these actions become internalized into an organized system. This internalization, however, is a gradual and an increasingly more complex process. "At first, the child seems to do little more than replicate in his head simple concrete action sequences he has just performed or is about to perform. As internalization proceeds, cognitive actions become more and more schematic and abstract (p. 82)."

Piaget is careful, however, to make a distinction between the content of thought and the thought process, itself. "Thinking is an action that transforms overtly or covertly one reality state into another (Furth, 1967, p. 820)." This action of transformation takes place within the context of a developing cognitive structure--schema which are ever-expanding, assimilating and accomodating to new experiences. The content of thought, on the other hand, consists of the ways in which the "end-points" of those transformational states are represented (Inhelder, 1969). Inferences can be made about the developing cognitive schemas by studying the ways in which the child represents his thought--in his judgments and performances on various tasks.

Piaget (1952) and his colleagues, notably Inhelder (Inhelder & Piaget, 1958, 1964), have described the development of intelligence in children as proceeding gradually from almost total reliance upon sensory-motor representations or expressions of thought through stages where objects and events are operated upon and represented only figuratively (i.e., imitated), then, with increasing independence from the objects themselves (i.e. symbolization), to the point where the child becomes able to operate upon the symbols, themselves. Piaget has classified these latter operations as concrete and formal. "Concrete . . . operations are actions performed on objects to bring them together into classes of various orders or to establish relations between them (Inhelder & Piaget, 1958, p. 273)." On the other hand, "thinking becomes formal . . . because it deals with the possible combinations (of concrete groupings) and no longer with objects directly (p. 293)."

Bruner (1964, 1966) described the development of representational thought via similar stages. At first, the child represents reality in an enactive mode through his actions and physical sensations. Later, the child makes use of visual and other sensory perceptions to form images of events and actions and so represent them in an ikonic mode. Finally, the development of language helps push the child into a symbolic system of representation which, as with Piaget, can be operated upon without the things represented being present directly in experience.

Many other researchers have also demonstrated that children's ability to think abstractly--to form and use categories and concepts--increases with age (Thompson, 1941; Kruglov, 1953; Sigel, 1953; Heald & Marzolf, 1953; Goldman & Levine, 1963; Shantz, 1967; Stone, 1968; Sigel & Kresh, 1971; Parker & Day, 1971; Overton & Brodzinsky, 1972). With respect to the first assumption, children's thought may be characterized as proceeding developmentally from perceptual, concrete operations and representations of thought to abstract, symbolic operations and representations.

Effects of Social Background on Performance

With the Civil Rights Act of 1964 and the Elementary and Secondary Education Act of 1965 a great deal of attention was focused on the poorer school performance of lower-class children and children from minority ethnic groups. The plight of these children has been well documented for many years (Bloom, 1964; Coleman, et al., 1966; Wilson, 1963). Their performance on a variety of intelligence and achievement tests has consistently been below that of white middle- and upper-class children.

A number of explanations for these differences have been proposed (Cicirelli, 1972). The most prevalent argument is that the environment of the lower-class child does not provide the experiences which encourage the development of academic skills. The disadvantaged child has poorly developed auditory and visual discrimination skills, and little ability to persevere at tasks, for example (Deutsch, 1963; Havighurst, 1964; Passow & Elliott, 1967). But, one of the greatest differences between children from advantaged and disadvantaged backgrounds is in the development and use of language (Deutsch, 1965). The majority of intelligence and achievement tests used in school depend heavily upon verbal and language factors (Eells & Davis, 1951) and research has demonstrated that the language skills of children from disadvantaged backgrounds are quite different from the skills of their middle-class peers (John, 1963; Deutsch, 1965). Bernstein (1958; 1959; 1960) characterized the language of the disadvantaged as "public" in form and use compared to the more "formal" verbal abilities of advantaged children. "Public" language involves more ". . . short commands, simple statements and questions where symbolism is descriptive, tangible, concrete, visual and of a low order of generality (1958, p. 164)." The "formal" language of middle and upper socio-economic groups is ". . . rich in personal, individual qualifications, and in its form implies a set of advanced logical operations (1958, p. 164)."

Also important is the use of language. Children acquire language via verbal interaction with others, especially their parents and, in particular, their mothers (Hess & Shipman, 1965). The child from the lower-class home, however, learns most of his language through receptive exposure rather than active interaction (John & Goldstein, 1964). In other words, the "public" language in the lower-class home is a one-way proposition. The language in the disadvantaged home limits the child's chances to examine alternatives, causes, or reasons for events. As a result, the child does not develop language as a "mediator" of thought, a prerequisite to effective logical thinking.

Thus, the child from a lower socio-economic home develops a sensitivity to the content or "boundaries" of objects and events (i.e., concrete stimuli), rather than to the structure of objects while, on the other hand, the "formal" language places greater emphasis on the interrelationships between objects and the differentiation among them (Bernstein, 1958).

A number of authors have thus characterized the thought of the disadvantaged child as more concrete and less abstract than that of the middle-class child (Jensen, 1969; Ausubel, 1968; Sigel & Olmstead, 1970; Blank & Solomon, 1968; Gordon, 1965; Passow & Elliott, 1967). Ausubel (1968) suggests that the "general unreadiness for school learning among culturally disadvantaged children largely reflects their slower and less complete transition from concrete to abstract modes of thought . . . (p. 269)." Training programs developed to increase the disadvantaged child's abstract thought processes are based on this hypothesis. "Their behavior [the deprived children] reflects the lack of a symbolic system by which to organize the plentiful stimulation surrounding them (Blank & Solomon, 1968, p. 380)." Such training programs have focused on skills of selective attention, imagery of future events, inner verbalization, cause and effect relations, categorization, and sequential thinking.

A number of other researchers have investigated the effects of socio-economic status upon intellectual development. Sigel and McBane (1967), Sharan and Weller (1971), and Wei (1971) found that lower-class children are retarded in development of Piagetian classification skills as compared to their middle-class peers. Stodolsky and Lesser (1967) also found that middle-class children were more advanced on Piagetian class inclusion and sorting tasks. Odom (1967) found that children from high socio-economic homes used an hypothesis-testing strategy in a concept formation task more often than lower-class children and Siller (1957) and Kruglov (1953) found that lower-class children selected more "concrete" definitions of words. Almy, Chittenden, and Miller (1966) also found differences between low- and middle-class children on classification and conservation tasks.

To summarize research pertinent to the second assumption, children from lower-class backgrounds appear to develop conservation concepts somewhat later than their middle-class peers and are less able to make use of "abstract" categories in concept formation and classification tasks. Considerable evidence indicates that differences in the experiences of the lower-class and middle-class home environments do exist and may contribute to differences in the representation of thoughts, and especially, language.

The Effects of Concrete Materials

Piaget (1971 ;Flavell, 1963) and Ausubel (1968) suggest that instructional materials should include audiovisual aids "to provide more concrete empirical props and opportunities for direct physical manipulation of objects and situations (Ausubel, 1968, p. 269)" for children from disadvantaged backgrounds. One example of such concrete materials is the Cuisenaire rods (Cuisenaire & Gattagno, 1960). Extensive research has been carried out with Cuisenaire rods in mathematics instruction but, in his review of a considerable number of studies comparing the use of the Cuisenaire rods with more traditional approaches in which concrete aids were not used, Fennema (1969) pointed out that manipulable devices have not contributed significantly or reliably to learning.

Piaget (1970), however, maintains that the Cuisenaire materials are useful when they permit active manipulations and discoveries by the child, himself, but when they are used by the teacher, for demonstrations, they make the figurative aspects of thought--the way thoughts are represented by the child--more important than the operations, themselves. This activity need not be a physical-motor response; it can easily be internal or abstract reflection, but no audio or visual aid--film or images--can help develop the child's operative ability unless the child actively interacts with the "content" they represent.

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With respect to overt operations, research on the effects of active manipulation has not been definitive. Huttenlocher (1962) found that manipulation of objects interfered with children's ability to form concepts. More recently, Goodnow (1969) and Goodnow and Bethon (1966) obtained evidence that children are able to give more non-standard uses for objects if they are allowed to handle them and that children from poorer schools perform more poorly on a classification task when they are not allowed to move the objects, themselves.

On the other hand, with respect to covert operations upon the objects or material involved, words or phrases with concrete referents or pictures have been used successfully to improve children's learning (Horvitz, 1971; Rohwer, 1970; Paivio, 1970; Palermo, 1970). Paivio (1965, 1970) proposes that the images serve as pegs to which the individual can attach verbal labels and thus they facilitate learning. Another proposal is that . . . "the image of the stimulus might be an initial implicit response that is more likely to produce additional verbal mediators, one of which might already be connected to the [appropriate] response (Bourne, Ekstrand, & Dominowski (1971, p. 142)." In other words, the creation of an image may help to mediate between more symbolic materials because the symbolic material may have already developed out of experiences encoded in, to user Bruner's term, ikonic representations (Bruner, 1966).

Some evidence exists that instructions to create images from materials facilitate the performance of older children more than younger children (Rohwer, 1970). Rohwer contends that children, up to the third grade, have less capacity for using images effectively than they have for making use of verbal representations. Older children (sixth-graders) are better able to make use of images because they are more likely to have a symbolic representation stored in memory and associated with the image. Because of the limitations of memory, younger children may not have this association.

Such an explanation appears to be consistent with Bruner's and Piaget's conceptions. They assert that language becomes the predominant developmental task for the child up to the age of seven or eight. Language enables the child to: ". . . represent [actions] intuitively by means of pictures and 'mental' experiments (Piaget, 1967, p. 17)." One might conclude, on the basis of this evidence, that image-suggesting materials can be most effective when there exists more symbolic materials easily and closely associated with them in the child's experience, thus providing the child with a greater opportunity to interact actively with the image.

A number of other researchers, in studies of cognitive functioning, have used materials which vary along dimensions of realism. Stevenson and McBee (1958) found that four- and six-year-olds made fewer errors on a size-discrimination

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task after training with three-dimensional objects (cubes) than with cardboard cut-outs or squares painted on cardboard. Thornburg and Fisher (1970) found that three- and four-year-olds discriminated letters better after play with three-dimensional letters than with two-dimensional letters even though the criterion task was two-dimensional. Hale (1971) presented third-, sixth-, and ninth-graders with paired-associate tasks using pictures, concrete words, abstract words, and Japanese characters. Subjects' performance on pictures was superior to their performance on concrete words in grades three and nine. The subjects' performance on concrete words was superior to that on abstract words in grades three and six.

Sigel (1954) compared seven-, nine-, and eleven-year-olds' classification abilities using five different forms of a test. One form of the test employed toy representations of objects to be sorted. The children were permitted to handle all of the objects. On a second form, the toys were present but the children were not allowed to touch them. The third form used black and white photographs of the toys which the children were also not permitted to touch. The fourth form of the test used the word-names of the objects, each printed on separate cards. The fifth form of the test used a single list of all the object names. Sigel found age differences but no differences between test forms.

Dwyer (1967, 1970) found that photographs and oral descriptions resulted in significantly poorer performance from subjects than did schematic diagrams or diagrams with limited shading. In his review of earlier research, Dwyer found that a controversy existed (Travers, 1967) between researchers who felt that learning increased as the number of cues in the situation increased and those who felt that too many cues could be debilitating; that part of the subject's job during learning is to separate or filter out the relevant from the irrelevant, and that too many, or too realistic, cues could make that job more difficult.

Thus, if the task (in Dwyer's studies, learning the parts of the heart) depended upon the cues presented in audio-visual materials, then the number of cues becomes crucial. Performance can be inhibited by being to abstract or too realistic. By the same token, if the cues presented in audio or visual or tactual materials do not directly reveal the relevant task dimension, as in the case of Sigel's research, no differences may result from different kinds of aids. Since all of the objects used by Sigel were carefully selected to be familiar to all children, no doubt the subjects' own referents, most likely affected by their age and experience, determined their performance and not the different test forms.

There is some evidence that more concrete, or realistic, materials do facilitate learning for disadvantaged pupils

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in particular (Securro & Walls, 1971; Semler & Iscoe, 1963). Semler and Iscoe found no differences between black and white children on a paired-associates task when the pairs were represented by real objects rather than with photographs. Younger black children had the greatest difficulty when the pairs to be learned belonged to different conceptual categories and were represented in pictures rather than real objects. Securro and Walls found that disadvantaged children outperformed their advantaged counterparts when learning relational concepts with lifelike stimuli (pictures) versus conjunctive concepts or abstract geometric figures.

To summarize, the use of more realistic and concrete materials has enhanced children's performance on a number of conceptual tasks. There is some concern expressed by Piaget, however, that greater realism not be considered an end in itself. To be effective, the concreteness of the materials must increase the child's cognitive operations with the materials. Otherwise, the increased number of cues may interfere with the child's ability to identify the relevant information.

Summary

Three theoretical assumptions were made in the course of the present review concerning the development of conceptual behavior in children, differences between children from culturally different backgrounds, and the use of realism in learning and teaching aids. The first of these assumptions, that conceptual behavior develops gradually with age out of more concrete modes of thought, has been well documented (Flavell, 1963; Bruner, 1964; Goldman & Levine, 1963; Sigel & Kresh, 1971). Older children are better able to make accurate judgments concerning relationships between objects and events under transformation. They have acquired concepts which enable them to separate relevant from irrelevant information.

Research concerning the second assumption, that children from lower-class homes or minority ethnic cultures have not developed this conceptual ability as fast as their middle-class peers, has also been reported (Wei, Lavatelli, & Jones, 1971; Wallach, 1963; Stodolsky & Lesser, 1967; Sigel & McBane, 1967; Sharan & Weller, 1970; Siller, 1957). To compensate for this "deficit," it has been proposed that learning and teaching aids for the "disadvantaged" should be made as concrete as possible (Ausubel, 1968).

Research concerning the use of realism in learning aids has, however, not been conclusive. Considerable research indicates that more concrete or realistic representations do enhance performance (Korvitz, 1971; Rohwer, 1970; Paivio, 1970; Stevenson & McBee, 1958; Hale, 1971) and some evidence exists that children from culturally different backgrounds perform better on tasks where greater concreteness is used (Semler & Iscoe, 1963;

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Securro & Walls, 1971). But, when the task to be performed does not depend upon the additional details of realism or concreteness, those details may interfere with performance (Dwyer, 1970, 1967).

Organization of Final Chapters of Project Report

The present experiments were conducted by two different teams of investigators working in the areas of concept formation and problem-solving, respectively. Therefore, the Methods, Results and Discussion of the Results sections will be reported separately, first for concept formation, and, second, for problem-solving.

CHAPTER III

Methods, Results and Discussion for Concept Formation

Method

Subjects

The 360 subjects were chosen from two schools in a large midwestern city, one located in the innercity and the other in a middle class neighborhood. The ethnicity composition of each school was predominately Caucasian. The innercity school was designated as a ESEA Title I school on the basis of the value of homes, family mobility, and parent income. For this study, the pupils in the innercity school was called disadvantaged while those in the middle class school were labeled advantaged. Classification by school rather than individual may have placed some subjects in the wrong SES group; i.e., some of the pupils in the innercity school may have come from middle class homes and some of the children from the suburban school may have come from lower class homes although the neighborhoods appeared rather homogeneous. This procedure could have resulted in failure to find SES differences when they in fact existed. From each school, three classes of approximately 30 pupils each were chosen at grade two and three classes at grade four. The three classes at each grade level were pooled and randomly assigned to three groups designated as concrete, film, and abstract.

Description of the Instruments

The two-part color motion picture test instrument consisted of conservation and discriminative response items. The 16 item conservation subtest consisted of three number, two length, three quantity, two mass, three area, one weight and two volume items. The film was projected in a partially lighted room and the subjects responded to questions by marking answer sheets.

A typical conservation item presented in the film asked the children to compare liquid quantity in different containers. Initially, they saw two identical glass tumblers of liquid filled to the same level, and set together to facilitate visual comparisons. The subjects were told that both tumblers contain equal amounts of juice.

Table 1

Federal Criteria Used to Judge Degree of Disadvantage of the Schools in the Concept Formation Experiment

Federal Criteria	City Average	School Advantaged	 Disadvantaged
Mobility (above .54)[1]	.33	.06	.43
Attendance (below 92.3%)	94.6	95.2	91.9*
Percent families with incomes less than $3000 (above 20%)	13	5.3	14.1
Percent approved indigents	13	0	15
Owner unit value real estate	$11,900	$12,800	$8,000*

[1] Federal Standard in parentheses

*Meets or exceeds criteria for disadvantaged classification.

Table 2

Number of Students Tested and the Percentage of Non-White Students at Each Grade Level in the Concept Formation Experiment

Grade		Schools	
		Advantaged	Disadvantaged
Second	Number	66	128
	% Non-White	1.5	0.8
Fourth	Number	62	110
	% Non-White	0.0	0.0

Then, they saw the liquid poured from one tumbler into a taller but smaller diameter container. The subjects were then asked which container held more juice, or if they had equal amounts. They were to respond by marking one of three pictures--a star to indicate more liquid in the container on the left, a key to indicate more liquid in the container on the right, or a flower (always in the middle) to indicate the amounts were equal.

In addition to items where the two stimuli were equal in the initial presentation, as above, there were items with initial inequality. For example, two tumblers of beans were presented with one obviously having more beans than the other. Then the contents of the one with less was poured into a tall, smaller diameter container with the height in this new container being greater than in the tumbler available for comparison.

For the concrete mode of the conservation subtest, the actual objects seen in the film were used and the transformation performed in clear view of all class members. The items were presented using a display board, flannel board and a table top.

The abstract mode of the conservation test was developed for this study. The difficult aspect of designing the test was the problem of representing a transformation on paper. A sequence of four drawings was used to depict change (transformation). The first drawing showed, for example, two glasses of liquid filled to the same height. The second drawing showed the liquid in one container being poured into a tall, thin cylinder. The third drawing showed the new container with liquid in it and the empty glass held above. The fourth drawing showed the two containers to be compared. In administering the test, subjects were given a piece of colored paper and asked to cover their page. Then on instruction they would slide it down to sequentially reveal the four drawings. Subjects were to mark the container in the fourth drawing which had more liquid or mark both if they had the same amount.

The sixteen items of the conservation test were taken from a 23-item film test developed previously (Asher, et. al. 1971). The test-retest reliability data of the original film test was available with first and third grade pupils. The reliabilities were 0.86 for the first grade and 0.72 for the third grade. The K-R 20 reliabilities of the concrete, film, and paper-pencil forms used in this study were 0.87, 0.77, and 0.84, respectively.

In the discriminative response task, the subject was shown a row of four drawings and told, "These are alike in some way." He was then shown a second row of four drawings and told, "These are not like those in the first row." Then he was instructed to "Mark the one in this row which is like those in the first row." There were five choices in this final row. The items themselves varied in the number of relevant attributes and the obviousness of the attributes. A typical item is shown in Figure 2.

The concrete mode of the discriminative response subtest consisted of painted wooden models of shapes mounted on a large poster which could be seen by the entire class. The film version of this subtest was prepared by filming the models used in the concrete modes. The abstract mode was prepared by drawing black outline sketches of the models on 8 1/2" x 11" paper.

Experimental Design

In attempting to determine the effects of age, concrete-abstractness level, and SES level, a design was chosen using grades two and four, the three levels of concrete-abstractness (concrete, film, abstract), two levels of SES; and disadvantaged and advantaged. A 2x2x2 analysis of variance design was used to identify main effects as well as possible interactions. Three separate analyses were performed, one using the sixteen item conservation data, one using the nine item conservation subtest data, and one using the discriminative response data.

Results - Concept Formation

The results of a 2x3x2 analysis of variance performed on the sixteen item conservation subtest data is shown in Table 3. There was a highly significant grade effect with fourth grade subjects scoring approximately two and one-half points higher than second grade subjects. there was no mode effect but a highly significant SES difference with the advantaged group scoring higher than the disadvantaged group. Nearly all of the SES difference resulted from second grade scores. Figure 3 (a) shows a Grade X Mode interaction. At grade two the mean score of the film group was higher than either the mean score of the concrete or abstract group. At the fourth grade the mean score of the film group was lower than either the concrete or abstract groups. Figure 3 (b) shows a Grade X SES interaction resulting from the disadvantaged fourth grade group scoring the same as the advantaged group, while at the second grade, the advantaged group scored higher than the disadvantaged group. Figure 3 (c) shows a Mode X SES interaction. This resulted from the concrete advantage groups scoring lower than the advantaged film or abstract groups while the concrete disadvantaged groups scored higher than with the disadvantaged film or abstract groups. There was no sex difference.

From the sixteen items of the conservation test, nine items were selected for analysis in which the initial presentation featured equal, rather than unequal quantities. This was done for two reasons. First,

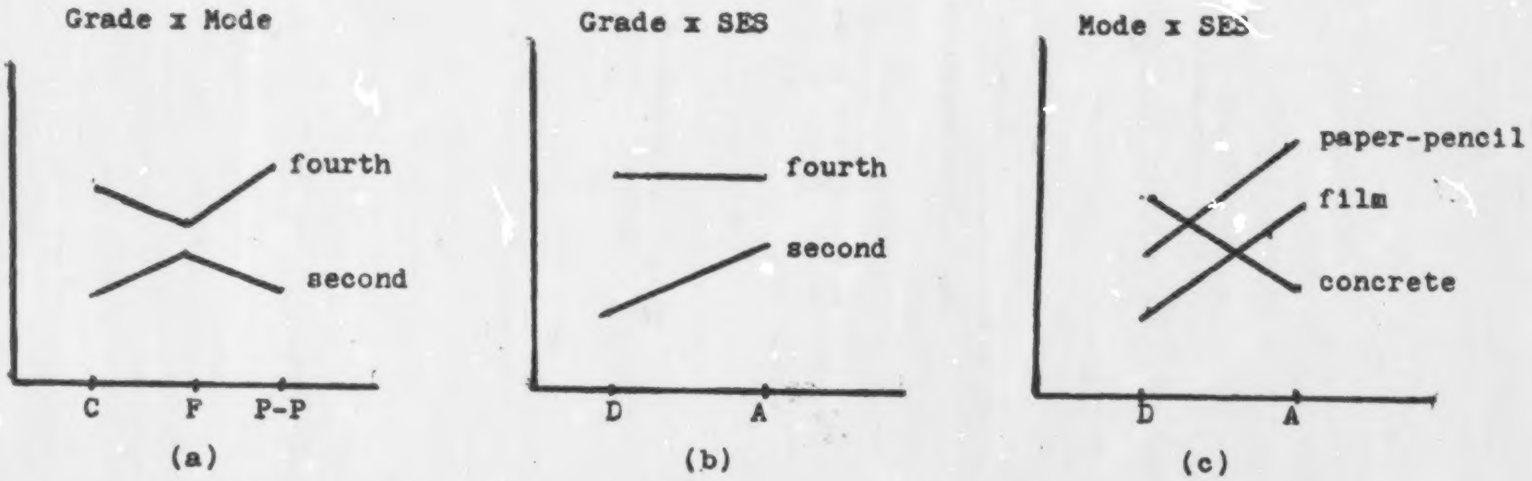
Table 3

2x3x2 Grade x Mode x SES ANOV for the sixteen item conservation subtest

	M.S.	D.F.	F ratio
A Grade	558.09	1	56.60 **
B Mode	9.77	2	.99
C SES	87.50	1	8.87 **
AB	37.94	2	3.85 *
AC	53.19	1	5.39 *
BC	39.39	2	4.00 *
ABC	13.76	2	1.40
Within	9.86	347	

* significant at the .05 level

** significant at the .01 level



(a) (b) (c)

Fig. 3 Sixteen item conservation test interactions

using equal quantities is the more standard method of assessing conservation and thus has greater logical validity. Secondly, in a factor analysis of the sixteen items the inequality items separated out from the equality items. Using the scores on the nine equality items, the same type of analysis of variance was performed. As before, there were highly significant grade and SES effects in the same direction (shown in Table 4). But in contrast to the previous analysis, there was a significant mode effect with scores on the abstract mode being lower than either the scores on the concrete or film tests.

Figure 4 shows the resulting interactions. There was a Grade X Mode interaction with several grade subjects scoring higher on the film test, and a Mode X SES interaction with the disadvantaged group scoring as high on the concrete form as the advantaged group. There was no sex difference.

A 2x3x2 Grade X Mode X SES analysis of variance was performed on the discriminative response data. There was a significant grade effect with fourth graders scoring higher than second graders. See Table 5. There was a significant mode effect resulting from higher scores on the abstract mode. There was no SES effect. There was a Grade X SES interaction, shown in Figure 5, resulting from a low second grade advantage group mean on the concrete mode.

The means and standard deviations for the three analyses are shown in Tables 6, 7, and 8.

The proportion correct for each of the sixteen items of the conservation test for the three modes is shown in Table 9. It can be seen that there were not items of the concrete mode markedly different in proportion correct from the other modes, but items 2, 12, and 15 of the film mode were markedly lower than the corresponding items of the other modes. These are

Table 4

2x3x2 Grade x Mode X SES ANOV for the nine item conservation (equality) subtest

	M.S.	D.F.	F ratio
A Grade	415.34	1	76.01 **
B Mode	30.13	2	5.51 **
C SES	61.28	1	11.22 **
AB	29.96	2	4.93 **
AC	14.31	1	2.62
BC	19.46	2	3.56 *
ABC	8.71	2	1.59
Within	5.46	343	

* significant at the .05 level

** significant at the .01 level

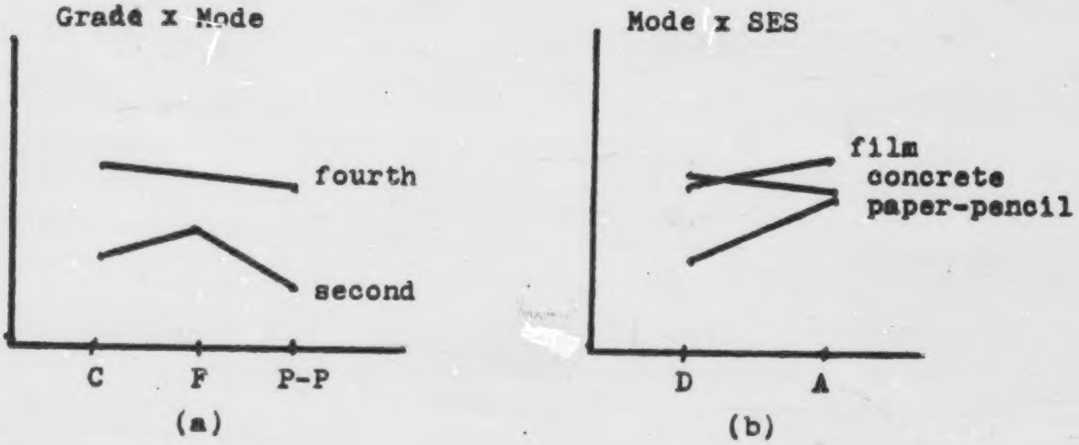


Fig. 4 Nine item conservation (equality) test interactions

Table 5

2x3x2 Grade x Mode x SES ANOV for the discrimirative response test

	M.S.	D.F.	F ratio
A Grade	273.68	1	53.55 **
B Mode	43.06	2	8.43 **
C SES	7.75	1	1.52
AB	1.06	2	.23
AC	22.71	1	4.44 *
BC	11.62	2	2.27
ABC	30.82	2	6.03 **
Within	5.11	347	

* significant at the .05 level

** significant at the .01 level

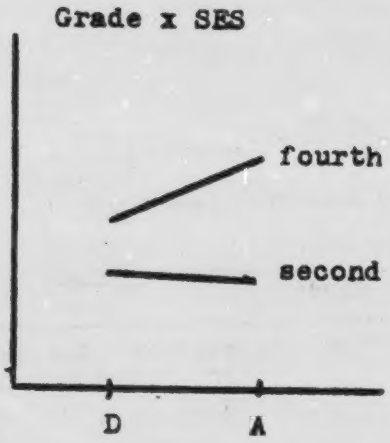


Fig. 5 Discriminative response test interactions

Table 6

Sixteen Item Conservation Test Means and Standard Deviations

Test Mode		Grade 2		Grade 4	
		Disadvantaged	Advantaged	Disadvantaged	Advantaged
Concrete	m	8.94	9.84	13.01	11.73
	s.d.	4.14	2.99	2.07	2.60
Film	m	9.29	10.90	10.48	12.11
	s.d.	3.05	2.66	2.95	2.51
Abstract	m	8.94	11.70	12.56	13.17
	s.d.	3.62	3.62	2.97	4.01

Table 7

Nine Item Conservation (Equality) Subtest Means and Standard Deviations

Test Mode		Grade 2		Grade 4	
		D	A	D	A
Concrete	m	4.82	5.23	8.08	7.58
	s.d.	3.24	3.13	1.57	1.66
Film	m	5.90	6.81	6.81	8.03
	s.d.	2.32	2.36	2.34	1.62
Abstract	m	3.32	5.77	6.92	7.50
	s.d.	1.81	3.60	2.33	2.40

Table 8

Discriminative Response Test Means and Standard Deviations

Test Mode		Grade 2		Grade 4	
		D	A	D	A
Concrete	m	5.26	3.68	5.65	6.64
	s.d.	2.34	1.97	2.65	1.87
Film	m	4.58	4.67	5.67	7.50
	s.d.	1.89	1.84	2.00	2.70
Abstract	m	5.21	6.10	7.48	7.07
	s.d.	2.23	2.06	2.52	2.80

Table 9

Proportion of Correct Responses for the Sixteen Item Conservation Test for Each of the Three Modes

Item			Test Mode		
			Concrete	Film	Abstract
1*	Number	=	.85	.80	.81
2	Number	≠	.90	.31	.93
3*	Number	=	.84	.78	.82
4	Length	≠	.87	.86	.94
5*	Length	=	.70	.86	.84
6	Quantity	≠	.65	.74	[illegible]
7*	Quantity	=	.64	.74	.50
8*	Mass	=	.78	.90	.59
9	Mass	≠	.86	.85	.70
10	Quantity	≠	.70	.80	.71
11*	Area	=	.54	.59	.65
12	Area	≠	.55	.39	.77
13*	Area	=	.60	.68	.53
14*	Weight	=	.69	.75	.60
15	Volume	≠	.80	.59	.86
16*	Volume	=	.77	.80	.48

*Items of initial equality used in subsequent analysis.

inequality items included primarily for variety and to lengthen the test. Of a substantive nature is the lower scores on items 6, 7, 8, and 16 of the abstract mode. These differences accounted for the significantly lower scores on the abstract mode when the nine conservation (equality) items were analyzed.

The proportion correct for each of the discriminative response items for the three modes is shown in Table 10.

Discussion - Concept Formation

The rather complex results of this study can be interpreted by considering a number of factors. The conservation test was first analyzed using all sixteen items, and then by using just the nine equality items. After careful examination of item proportions, factor analysis, and the nature of items, it was concluded that the results of the nine item analyses were more meaningful. In a previous study (Wheatley, 1972), the equality items were shown to be highly discriminative and reliable. On the equality conservation subtest, the scores were highest on the concrete and film modes and lowest on the abstract modes. Fourth grade subjects scored much higher than second grade subjects and advantaged subjects scored higher than disadvantaged subjects. The one interaction of particular interest was Instrument X SES. While there was no difference in performance of the two SES groups on the concrete mode, there were significant differences on the two more abstract modes of presentation in favor of the advantaged group. The second grade disadvantaged group scored much lower on the abstract mode. They had 36% correct responses compared to 56% and 63% for the second grade disadvantaged concrete and film groups respectively. The second grade advantaged group had 64% correct responses on the abstract mode. Evidently the greater abstraction in mode of presentation was less interpretable to the young disadvantaged children.

Table 10

Proportion of Correct Responses for the Discriminative Response Items

	Test Mode		
Item	Concrete	Film	Abstract
1	.50	.82	.57
2	.07	.16	.26
3	.49	.46	.66
4	.54	.46	.69
5	.70	.78	.85
6	.51	.51	.51
7	.60	.60	.79
8	.53	.44	.42
9	.47	.46	.47
10	.00	.05	.40
11	.28	.38	.28
12	.60	.55	.62

There is support in the conservation data for the conclusion that an intermediate level of abstractness in stimulus presentation results in higher performance. In three out of four comparisons available for the three forms, the intermediate level of abstraction (film) resulted in higher scores.

The paper-and-pencil method of assessing conservation ability used in this study is quite novel. All evidence to date indicates that this test does in fact assess conservation with results comparable to individual testing. The portrayal of a transformation via a sequence of drawings may be useful in other contexts.

Scores were significantly higher on the abstract mode of the discriminative response test. One explanation of this can be found by analyzing the number of irrelevant attributes in the modes of presentation. Both the concrete and the film modes had irrelevant attributes of color, texture, and depth as potential distractors not present in the abstract mode. The abstract form consisted of black outline drawings on white paper, a more salient presentation of the concepts than the three-dimensional models used in the other two forms. This finding is consonant with Dwyer's (1970) conclusion that actual pictures or verbal descriptions do not yield scores as high as do schematic diagrams. There was one notable exception to this trend--the scores of the younger disadvantaged subjects were not higher on the abstract mode. This may indicate that in general young disadvantaged children are less capable of coping with abstract stimuli even when it is schematic.

In examining the socioeconomic factor in performance, an SES effect on conservation scores was found but the picture for discriminative response tasks was more complex. While there was no overall SES effect, there was a Grade X SES interaction with fourth grade subjects showing the expected higher scores for advantaged subjects. The absence of a SES difference at the second grade is difficult to explain. While the advantaged subjects scored higher on the film and abstract modes, this was not the case for the concrete mode. The advantaged group actually scored lower than the disadvantaged group on the concrete mode. Not only was the advantaged subjects' performance much lower on the concrete mode, the disadvantaged subjects scored higher on the concrete mode than on either the film or abstract mode. The existence of no overall SES difference for the discriminative tasks is consistent with the finding of Securro and Walls, 1971. They concluded that in the classroom, disadvantaged children as a group may attain concept tasks as efficiently as advantaged children ---" (Securro and Walls, 1972, p. 537). The existence of SES differences for the conservation tasks would be expected on the basis of the developmental nature of such concepts. There may be considerable value in using an extremely concrete presentation with disadvantaged children.

An interesting adjunct to the findings of this study lies in the support given for film testing of conservation. The fact that the concrete and film forms of conservation had almost identical means is encouraging to those wishing to use the more controlled film testing of conservation.

CHAPTER IV

Methods, Results and Discussion for Problem-Solving

METHOD

Although Experiment II was intended to be a replication of Experiment I, the subjects, procedures, instruments, and equipment used in both experiments will be discussed separately. The procedures of the reliability study will then be explained and, finally, the design, statistics, and computer programs used in both experiments will be reported.

The First Experiment - Subjects

In the first experiment 410 second and fourth grade children from two schools in Indianapolis, Indiana, were used as subjects. The schools were selected on the basis of Federal criteria used to judge the degree of disadvantage of the children attending. Table 1 presents the standing of the two schools with respect to these criteria. As can be seen from the table, neither of the schools meets or exceeds the Federal standards for the "disadvantaged" classification. However, there are large differences between the schools in terms of pupil mobility, family income, percent of indigents, and real estate value. In addition, the percentage of white and non-white students attending each school was obtained. Table 2 presents the

Table 1

Federal Criteria Used to Judge Degree of Disadvantage of the Schools in the First Experiment

Federal Criteria	City Average	School A	 B
Pupil mobility index (above .54)[1]	.33	.21	.09
Percent attendance (below 92.3%)	94.6%	95.3%	95.5%
Percent families with income less than $3,000. (above 20%)	13	4.8	2.1
Percent approved indigents (above 25%)	13	6	1
Owner unit value real estate (below $8,600)	$11,900	$13,800	$17,200

[1] Federal standard in parentheses.

percentage of non-white students at each grade level. As can be seen from the table, one school involved in the first experiment enrolled almost all non-white students, while the second school enrolled approximately half white and half non-white students.

The First Experiment - Procedures

Three classrooms were chosen within each grade level in each school. The Ss in these classes were then randomly assigned to one of the four testing forms. All Ss were tested in groups in regular classrooms. Experienced E's administered each of the test forms. The E's duties included a brief introduction on the nature of the test, answering questions from the children, operating the tape recorder and/or the slide projector (for the slide form), passing out and collecting the test booklets, and, in the case of the model form, holding the model in front of the class in a "stage-like" arrangement to be described later. All of the test directions, item alternatives for the test, regardless of form, were recorded on tape by an experienced announcer to minimize reading difficulty and increase E consistency. A copy of each test form and script for each form are included in the Appendix. Each testing session lasted approximately twenty to thirty minutes.

Table 2

Number of Students Tested and the Percentage of Non-White Students at Each Grade Level in the First Experiment

Grade		School	
		A	B
Second	Number	116	95
	% Non-White	93.2	47.4
Fourth	Number	97	102
	% Non-White	96.1	46.0

The First Experiment - Instruments

Performance on the Purdue Elementary Problem-Solving Inventory (Feldhusen, Houtz, & Ringenbach, 1972) was the dependent variable in the present experiment. The inventory was developed to assess the general problem-solving abilities of elementary school children from different ethnic and socio-economic backgrounds. The inventory consists of 47 multiple choice items in which realistic situations are presented to children by means of cartoon line drawings. The drawings are presented as black and white slides with an accompanying audio tape of all directions, item descriptions and item alternatives to minimize reading differences between groups of children. Research with the inventory (Asher, Feldhusen, Gruen, Kane, McDaniel, Towler, Stephens, & Wheatley, 1971) has demonstrated that the inventory discriminates children from different grade levels, ethnic identities, and socio-economic levels.

For the present experiment the Purdue Inventory was shortened to twenty-five items, based on item analysis data obtained from samples of children similar in characteristics to the present target population (Asher, et al., 1971). Three new methods of presenting these items were developed. Verbal descriptions of the cartoon drawings for the twenty-five items were written and substituted for the pictures (Lewis, et al., 1973). Three-dimensional, full-color models, measuring roughly 18 inches by 14 inches on the base and 14 inches high, were also constructed from the pictures (Ringenbach, et al., 1973). Finally, the cartoon drawings themselves, were reduced in size and placed in the test booklets. Thus, four methods of presentation of the items were used: I) a test in which verbal descriptions in paragraph form were placed in the test booklets and no pictures were shown; II) a form in which pictures were placed in the booklets; III) a form in which the cartoons were shown as slides, as in the original form of the inventory; and IV) a form in which the models were used instead of pictures or slides to present the problem situations.

Trial runs were conducted with second-and third-graders from the West Point School, West Point, Indiana, with the totally new forms of the inventory: the models, the abstract form, and the picture-book form. Item analysis data revealed patterns of responses to each of the items on the three new forms which were similar to the original slide form.

The First Experiment - Equipment

No special equipment other than tape recorders and a slide projector were used in the experiment with the exception of a specially-constructed "stage" for the model form. This stage consisted of three four-foot by eight-foot sheets of fiber-board fastened to a wood frame and hinged together vertically in the shape of a bay. Out of the center piece an 18" by 24" rectangular opening was cut at a height of 36". Each of the models was shown through this opening on a small platform. The models can be easily turned, and the height of the opening and angle of the platform were determined through trial runs for easy viewing by all Ss in the class.

The Second Experiment - Subjects

The Ss for the second experiment were second- and fourth-graders from five different schools in Indianapolis, Indiana. The schools were chosen on the basis of the same Federal criteria as in the first experiment for judging the degree of disadvantage of pupils. Table 3 presents the standings of the five schools with respect to each of the Federal criteria. Also, the percentage of white and non-white students attending each school was obtained. Table 4 presents this data by grade level.

The Second Experiment - Procedures, Instruments, and Equipment

The identical randomization and test administration procedures were followed in the second as in the first experiment. The same test forms--booklets, scripts, slides, and models--were used. The same E's were also employed. One of the problems encountered in the first experiment was the failure of some of the tape recorders during test administration. In the second experiment, with the same types of equipment, all of the recorders operated properly.

Table 3

Federal Criteria Used to Judge Degree of Disadvantage of the Schools in the Second Experiment

		School				
Federal Criteria	City Average	C	D	E	F	G
Pupil mobility index (above .54) [1]	.33	.62*	.53	.81*	.29	.05
Percent attendance (below 92.3%)	94.6	89.3*	98.1	90.7*	92.5	95.5
Percent families with income less than $3000. (above 20%)	13	29.6*	24.7*	23.7*	8.3	8.6
Percent approved indigents (above 25%)	13	35*	31*	44*	7	0
Owner unit value real estate (below $8600)	$11,900	$6300*	$7100*	$9700*	$12,200	$12,600

[1] Federal Standard in parentheses.

*Meets Federal criteria for the disadvantaged classification.

Table 4

Number of Students Tested and the Percentage of Non-White Students at Each Grade Level in the Second Experiment

Grade		Schools C	D	E	F	G
Second	Number	38	61	107	123	107
	% Non-White	0	4.9	93.5	99.2	0
Fourth	Number	44	60	114	100	124
	% Non-White	0	8.3	93.0	100	0

Reliability Study

The reliability of the Purdue Elementary Problem Solving Inventory, .79, as reported earlier, is an internal consistency estimate (KR-20, Downie, 1967). As a part of the present study an effort was also made to secure a test-retest reliability estimate. Two weeks after the Ss in the advantaged school in the first experiment were tested, they were retested in the same manner on the slide and the abstract test forms. Because of the inconvenience of transporting the models and stage, coefficients of equivalence and stability were computed between the slides and models, and picture-book and models forms. An attempt was also made to get test-retest reliability data for the picture-book form but equipment failures and other test administration difficulties made the data of the retest unusable.

Experimental Design and Statistics Used

The design of the first experiment was a 2 x 2 x 4 factorial with two levels of grade (second and fourth), two levels of degree of disadvantage (advantaged and disadvantaged), and four test forms (I. Abstract Stories, II. Picture-book, III. Slides, and IV. Concrete Models). In the second experiment, the additional factor of ethnicity (white and non-white) was included.

To analyze the data, analyses of variance, the t-test, and the w^2 statistic were computed (Winer, 1971; Hays, 1963). Post hoc comparisons of means were made using the Newman-Keuls procedure (Winer, 1971). The level of significance was set at .025 for the examination of the four experimental hypotheses and .05 for all other comparisons.

The data analyses were computed separately for each experiment because of the nature of the subject samples. In the first experiment it should be recalled that neither of the two schools involved met any of the Federal criteria for disadvantaged status and differed considerably in terms of the percentage of non-white students attending, while in the second experiment, three of the schools met several of the criteria and all of the schools enrolled white or non-white students at approximately the same percentage levels.

Computer Programs Used

For the analyses of variance, two programs from the EDSTAT library were run on Purdue's CDC 6500 computer: AVAR 23 for the first experiment and AOVB for the second experiment. Both AVAR 23 and AOVB make use of an unequal cell-size, least squares analysis of variance procedure (Winer, 1971). In addition, to compute the test-retest reliabilities of the different test forms, the TRECOR program, written at Purdue, and making use of the Pearson-Product Moment correlation procedure (Downie, 1967), was used.

RESULTS

The results of the Experiments I and II will be presented in the following order: the reliabilities of the test forms used, the difference between the mean performances of Ss in the two experiments, the results of the analyses of variance for both experiments, and the results of the simple main effects of test form and ethnicity in both experiments.

Reliabilities of the Test Forms

The test-retest reliabilities of the slides and abstract test forms were computed to be .69(N = 45), and .70(N = 56), respectively. The coefficient of equivalence and stability between the slides and the models forms and between the picture-book and the models forms was .73 (N = 25) and .83(N=20), respectively. Table 5 presents the Kuder-Richardson Formula 20 (Downie, 1967) estimates of reliability which were computed for each test form and at each level of degree of disadvantage in both experiments. As can be seen from the table, the coefficients of internal consistency are moderately high for each test form in both experiments regardless of degree of disadvantage of Ss.

Table 5

Kuder-Richardson Formula 20 Estimates of the Test Form Reliabilities for All Children and for Advantaged and Disadvantaged Children in Both Experiments

Effect		Experiment	Test Form Concrete Models	 Slides	 Picture-Book	 Abstract Stories
All Subjects		I	.64	.64	.55	.72
		II	.72	.67	.79	.63
Degree of Disadvantage	Advantaged	I	.72	.75	.85	.67
		II	.67	.67	.41	.78
	Disadvantaged	I	.49	.63	.54	.60
		II	.71	.49	.66	.55

Difference Between Experiments I and II

As discussed earlier, the schools involved in Experiments I and II differed in terms of the Federal criteria used to judge degree of disadvantage and in terms of the ethnic make-up of their student populations. A t-test between the grand means of both experiments was significant ($t = 8.45$, $df = 1201$, $p < .01$). Table 6 presents the grand means and standard deviations of the performance of all subjects in both experiments.

Analyses of Variance

Main Effects

Tables 7 and 8 present the results of the analyses of variance for Experiments I and II, respectively. In both experiments, the main effects of grade, degree of disadvantage and test form were significant. In the second experiment, the main effect of ethnicity was also significant. In both studies, the fourth-graders outperformed the second-graders and the advantaged children outperformed the disadvantaged children. In the second experiment, the white children outperformed the non-white children. Table 6 also presents the means and standard deviations of all main effects of both experiments.

In all subsequent reporting of comparisons, test forms will be identified by name and by number in parenthesis. The story form is (I), picture-book is (II), slide form is

Table 6

Grand Means and Standard Deviations and Means and Standard Deviations for All Main Effects for Both Experiments

		Experiment					
		I			II		
Effect	Level	Mean	S.D.	N	Mean	S.D.	N
All Subjects		15.94	3.14	410	14.21	3.46	793
Grade	Second	14.61	3.25	211	12.04	3.41	383
	Fourth	17.34	3.01	199	16.24	3.51	410
Degree of Disadvantage	Advantaged	16.92	3.12	197	14.89	3.81	449
	Disadvantaged	15.04	3.15	213	13.39	3.15	344
Ethnicity	White				15.59	3.59	385
	Non-white				12.80	4.14	408
Test Form	Abstract Stories	14.67	3.24	110	13.45	3.25	191
	Picture-book	17.06	2.97	94	14.29	4.13	196
	Slides	16.54	3.08	105	14.44	3.19	195
	Concrete Models	15.64	3.22	101	14.37	3.19	211

Table 7

ANOVA of Children's Performance

in the First Experiment

Source	df	MS	F	p	w^2
A Grade	1	747.44	76.09	<.01	.132
B Degree of Disadvantage	1	352.51	35.89	<.01	.062
C Test Form	3	111.19	11.32	<.01	.054
AB	1	48.93	4.98	<.05	.007
AC	3	41.08	4.18	<.01	.017
BC	3	16.56	1.69	n.s.	
ABC	3	13.58	1.38	n.s.	
Error	394	9.82			

Table 8

ANOVA of Children's Performance

in the Second Experiment

Source	df	MS	F	p	w^2
A Grade	1	3191.67	318.73	<.01	.239
B Degree of Disadvantage	1	409.14	40.86	<.01	.030
C Ethnicity	1	1258.31	124.66	<.01	.093
D Test Form	3	38.44	3.84	<.01	.006
AB	1	128.18	12.80	<.01	.009
AC	1	19.80	1.98	n.s.	
AD	3	36.21	3.62	<.05	.006
BC	1	145.10	14.49	<.01	.010
BD	3	1.32	.13	n.s.	
CD	3	24.44	2.46	n.s.	
ABC	3	39.01	3.90	<.01	.006
ACD	3	17.62	1.76	n.s.	
BCD	3	16.89	1.69	n.s.	
ABCD	3	21.94	2.19	n.s.	
Error	754	10.01			

(III), and models, (IV). This continuum from I to IV is the abstract to concrete direction of the continuum.

The Newman-Keuls procedure was used to test the differences between the mean performances of children on each test form. In both experiments, the stories form (I) of the test resulted in significantly lower performance than any other test form [$p < .01$, except for the models form (IV) where, in both experiments, $p < .05$]. In the first experiment, the models (IV) form resulted in significantly lower performance than the picture-book (II) form ($p < .05$).

Interaction Effects

A significant interaction was obtained between the factors of degree of disadvantage and ethnicity in the second experiment. Table 9 presents the means and standard deviations of children's performance by degree of disadvantage and ethnicity. The Newman-Keuls procedure revealed that the performance of advantaged white children was significantly higher than that of all other children and that the performance of disadvantaged white children was significantly higher than that of the non-white children ($p < .01$). The performance of advantaged and disadvantaged non-white children did not differ significantly.

In addition, in both experiments, a significant interaction was obtained between the factors of degree of disadvantage and grade ($p < .05, .01$, respectively). Table 10 presents the means of subjects' performance in both

Table 9

Means and Standard Deviations of Children's Performance in the Second Experiment by Degree of Disadvantage and Ethnicity

	Degree of Disadvantage					
	Advantaged			Disadvantaged		
Ethnicity	Mean	S.D.	N	Mean	S.D.	N
White	16.73	3.64	233	14.44	3.47	152
Non-White	12.97	4.48	216	12.63	3.74	192

Table 10

Means and Standard Deviations of Children's Performance in Both Experiments by Grade and Degree of Disadvantage

		Experiment					
		I			II		
Grade	Degree of Disadvantage	Mean	S.D.	N	Mean	S.D.	N
Second	Advantaged	15.20	3.13	95	12.37	3.50	230
	Disadvantaged	14.02	3.31	116	11.71	3.27	153
Fourth	Advantaged	18.63	3.11	102	17.41	3.70	219
	Disadvantaged	16.06	2.89	97	15.07	3.26	191

experiments by grade and degree of disadvantage. The Newman-Keuls procedures indicated that, in both experiments, advantaged fourth-graders outperformed all other children ($p < .01$). Disadvantaged fourth-graders outperformed disadvantaged second-graders in both experiments ($p < .01$). Finally, advantaged second-graders outperformed disadvantaged second-graders in both experiments ($p < .01$, .05, respectively).

In both experiments, a significant grade by test form interaction was also obtained ($p < .01$, .05, respectively). Table 11 presents the means and standard deviations of children's performance by grade and test form. The Newman-Keuls procedure revealed the following significant differences between means: in the first experiment, the second-graders on the models (IV) form outperformed the second-graders on the stories (I) form ($p < .01$); in both experiments, the second-graders on the slide (III) form outperformed the second-graders on the stories (I) form ($p < .05$, .01, respectively); the second-graders on the slide (III) form in the second experiment also outperformed the second-graders on the models (IV) form ($p < .01$); in the first experiment, the fourth-graders on the slide (III) form outperformed the fourth-graders on the stories (I) form ($p < .05$); in the second experiment, the fourth-graders on the models (IV) form outperformed the fourth-graders on the stories (I) form ($p < .01$).

Table 11

Means and Standard Deviations of Children's Performance in Both Experiments on Each Test Form by Grade

		Experiment					
		I			II		
Grade	Test Form	Mean	S.D.	N	Mean	S.D.	N
Second	Abstract Stories	12.63	3.36	51	11.76	3.20	95
	Picture-book	16.48	3.20	52	12.19	3.70	94
	Slides	14.56	3.08	54	12.57	3.18	95
	Concrete Models	14.52	3.35	54	11.64	3.53	99
Fourth	Abstract Stories	16.45	3.13	59	15.15	3.30	96
	Picture-book	17.65	2.66	42	16.39	4.49	102
	Slides	18.53	3.08	51	16.32	3.19	100
	Concrete Models	16.75	3.06	47	17.09	2.86	112

Finally, a significant grade by degree of disadvantage by test form interaction was obtained in the second experiment. Table 12 presents the means and standard deviations of children's performance by grade, degree of disadvantage, and test form. The Newman-Keuls procedure revealed a number of significant differences between means, but only one comparison was relevant to the present experiments: advantaged fourth-graders on the slide (III) form outperformed the advantaged fourth-graders on the stories (I) form ($p < .05$).

Additional computations, as suggested by Marascuilo and Levin (1970), were made to further identify the effects which contributed to this significant interaction. The Marascuilo and Levin procedures involve the calculation of estimates of the effects of factors and confidence intervals for those parameters. Table 13 presents the estimates of the effects of each combination of grade, degree of disadvantage, and test-form.

The confidence interval for the three-way effects was computed to be ± .64 for the .05 level and ± .77 for the .01 level. As can be seen from the table, the effect of models on disadvantaged children, of slides with fourth-graders, of pictures with advantaged children, and of stories with advantaged second-graders all contributed significant amounts of variation.

Table 12

Means and Standard Deviations of Children's Performance on Each Test Form in the Second Experiment by Grade and Degree of Disadvantage

		Degree of Disadvantage					
		Advantaged			Disadvantaged		
Grade	Test Form	Mean	S.D.	N	Mean	S.D.	N
Second	Abstract Stories	12.27	2.99	62	10.96	3.56	33
	Picture-book	12.31	4.12	55	11.82	3.00	39
	Slides	12.16	3.53	55	12.50	2.63	40
	Concrete Models	12.64	3.33	58	10.78	3.80	41
Fourth	Abstract Stories	15.94	3.64	52	13.27	2.81	45
	Picture-book	17.95	4.81	57	15.17	4.25	41
	Slides	18.25	3.04	52	15.37	3.25	51
	Concrete Models	18.24	3.00	58	16.09	2.71	54

Table 13

Estimates of Parameters for Grade by Degree of Disadvantage by Test Form Interaction in the Second Experiment

Grade	Degree of Disadvantage	Test Form			
		Models	Slides	Picture-book	Stories
Second	Advantaged	.35	-.31	1.11*	.81*
	Disadvantaged	-2.19*	-.06	.16	-.44
Fourth	Advantaged	-.48	.78*	1.57*	.10
	Disadvantaged	-1.37*	-1.16*	-.29	.28

Degree of Association

The degree of association (Hays, 1963) was also computed for each of the significant main effects and interactions. As can be seen from Tables 7 and 8, the factors of grade, degree of disadvantage, and ethnicity accounted for the largest amounts of variation. The factor of test form accounted for approximately five percent of the variation in the first experiment but less than one percent in the second. All of the interactions in both experiments each accounted for approximately one percent of the variation.

Simple Main Effects of Test Form

To examine the effects of test form among advantaged and disadvantaged children, simple main effects of test form at each level of degree of disadvantage were computed and are presented in Table 14. The mean performance of children by test form and degree of disadvantage are presented in Table 15 and Figures 1 and 2. In both experiments, the simple main effects of test form among the advantaged children were significant ($p < .01$). In the first experiment, the simple main effect of test form among the disadvantaged children was also significant ($p < .01$). In the first experiment, among the advantaged children, the picture-book (II) resulted in significantly higher performance than the stories (I) form ($p < .01$). In the

Table 14

Simple Main Effects of Test Form for Advantaged and Disadvantaged Children in Both Experiments

Experiment I

Source	df	MS	F	p
Test Form at Adv.	3	44.82	4.56	< .01
Test Form at Disadv.	3	65.98	6.72	< .01
Error	394	9.82		

Experiment II

Source	df	MS	F	p
Test Form at Adv.	3	31.71	3.17	< .01
Test Form at Disadv.	3	12.74	1.27	n.s.
Error	754	10.01		

Table 15

Means and Standard Deviations of Children's Performance in Both Experiments by Degree of Disadvantage and Test Form

		Experiment					
		I			II		
Degree of Disadvantage	Test Form	Mean	S.D.	N	Mean	S.D.	N
Advantaged	Abstract Stories	15.61	3.41	58	14.12	3.30	114
	Picture-book	18.36	2.68	43	14.99	4.48	112
	Slides	16.91	2.77	48	15.30	3.30	107
	Concrete Models	16.78	3.44	48	15.15	3.17	116
Disadvantaged	Abstract Stories	13.73	3.04	52	12.79	3.17	77
	Picture-book	15.77	3.20	51	13.59	3.60	84
	Slides	16.18	3.32	57	13.59	3.05	88
	Concrete Models	14.49	3.01	53	13.58	3.22	95

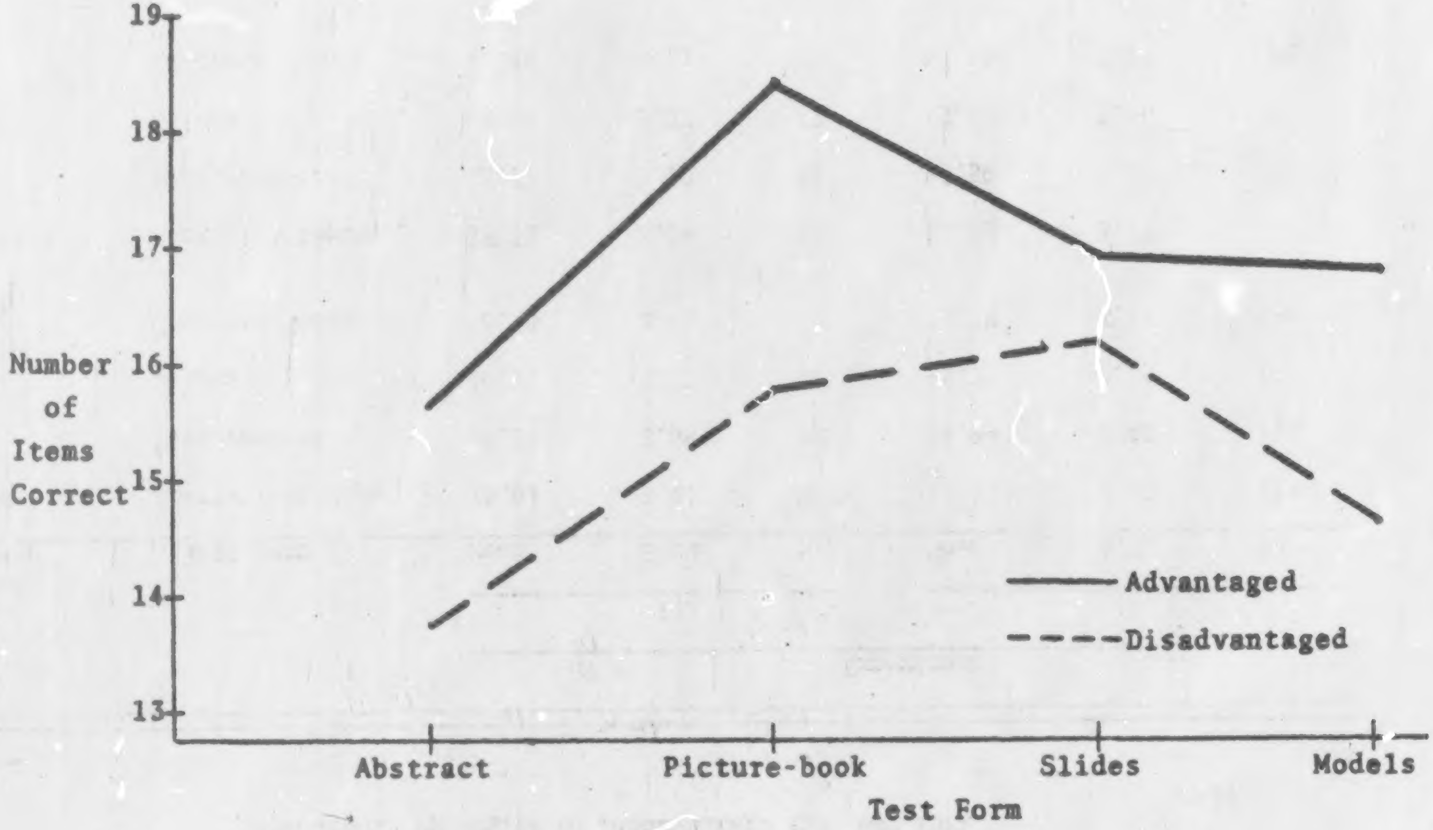


Figure 1

Performance of Advantaged and Disadvantaged Children

in the First Experiment on Each Test Form

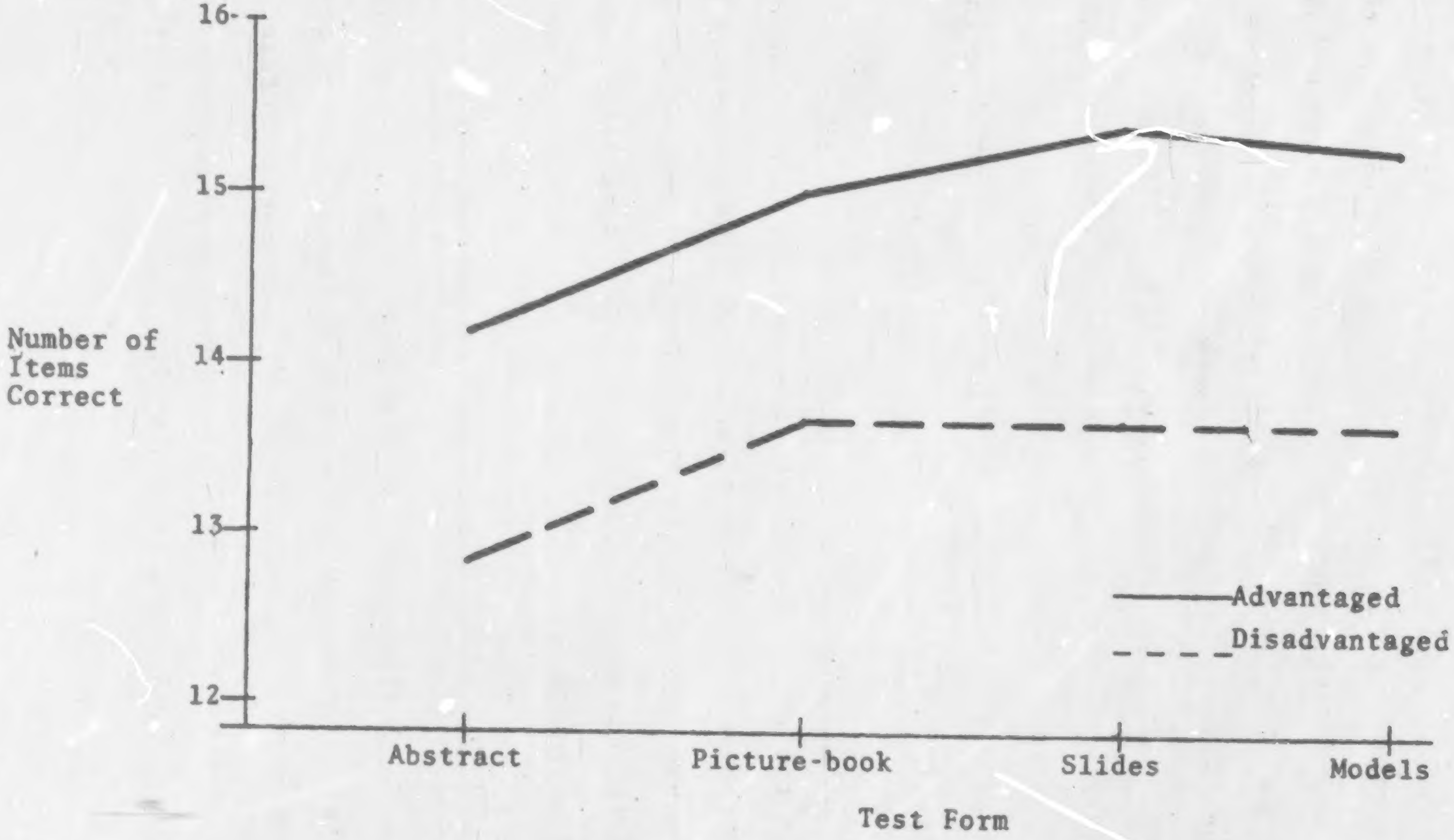


Figure 2

Performance of Advantaged and Disadvantaged Children in the Second Experiment on Each Test Form second experiment, among the advantaged children, the picture-book (II) form, the models (IV) form, and the slide (III) form all resulted in significantly higher performance than the stories (I) form ($p < .05$). In the first experiment, among the disadvantaged children, both the slide (III) form and the picture-book (II) form resulted in significantly higher performance than the stories (I) form ($p < .01$). In addition, the slide (III) form resulted in significantly higher performance than the models (IV) form ($p < .05$). In the second experiment, the simple main effect of test form among the disadvantaged children was not significant.

Effects of Ethnicity in Experiments I and II

In the first experiment, the advantaged and disadvantaged schools differed in terms of the ethnic identity of their students. While the disadvantaged school enrolled almost all non-white students, the advantaged school enrolled approximately equal numbers of white and non-white students (see Table 2). Table 16 and Figure 3 present the means and standard deviations for white and non-white students in both experiments on each test form. An additional analysis of variance was computed for the effects of grade, ethnicity, and test form for children in the advantaged school in the first experiment. The results of this analysis are presented in Table 17. The factors of grade,

Table 16

Means and Standard Deviations of White and Non-White Children on Each Test Form in Both Experiments

		Experiment								
		I (Advantaged)			I (Disadvantaged)			II		
Test Form	Ethnicity	Mean	S.D.	N	Mean	S.D.	N	Mean	S.D.	N
Abstract Stories	White	16.51	4.28	18				14.19	3.31	94
	Non-White	14.60	3.16	30	14.67	3.24	110	12.06	3.47	98
Picture-Book	White	19.51	1.89	18				16.07	4.07	97
	Non-White	17.31	3.05	30	17.06	2.97	94	12.59	4.75	95
Slides	White	17.79	3.47	22				15.88	3.24	91
	Non-White	15.44	3.90	21	16.54	3.08	105	13.47	4.14	107
Concrete Models	White	18.09	3.45	24				16.20	3.65	103
	Non-White	14.67	3.57	34	15.64	3.22	101	13.08	4.12	108

Table 17

ANOVA of Children's Performance in the Advantaged School in the First Experiment by Grade, Ethnicity and Test Form

Source	df	MS	F	p	w^2
A Grade	1	539.69	63.38	<.01	.28
B Ethnicity	1	273.16	32.08	<.01	.099
C Test Form	3	64.59	7.59	<.01	.063
AB	1	.36	.04	n.s.	
AC	3	34.19	4.02	<.01	.029
BC	3	4.87	.57	n.s.	
ABC	3	2.85	.34	n.s.	
Error	181	8.52			

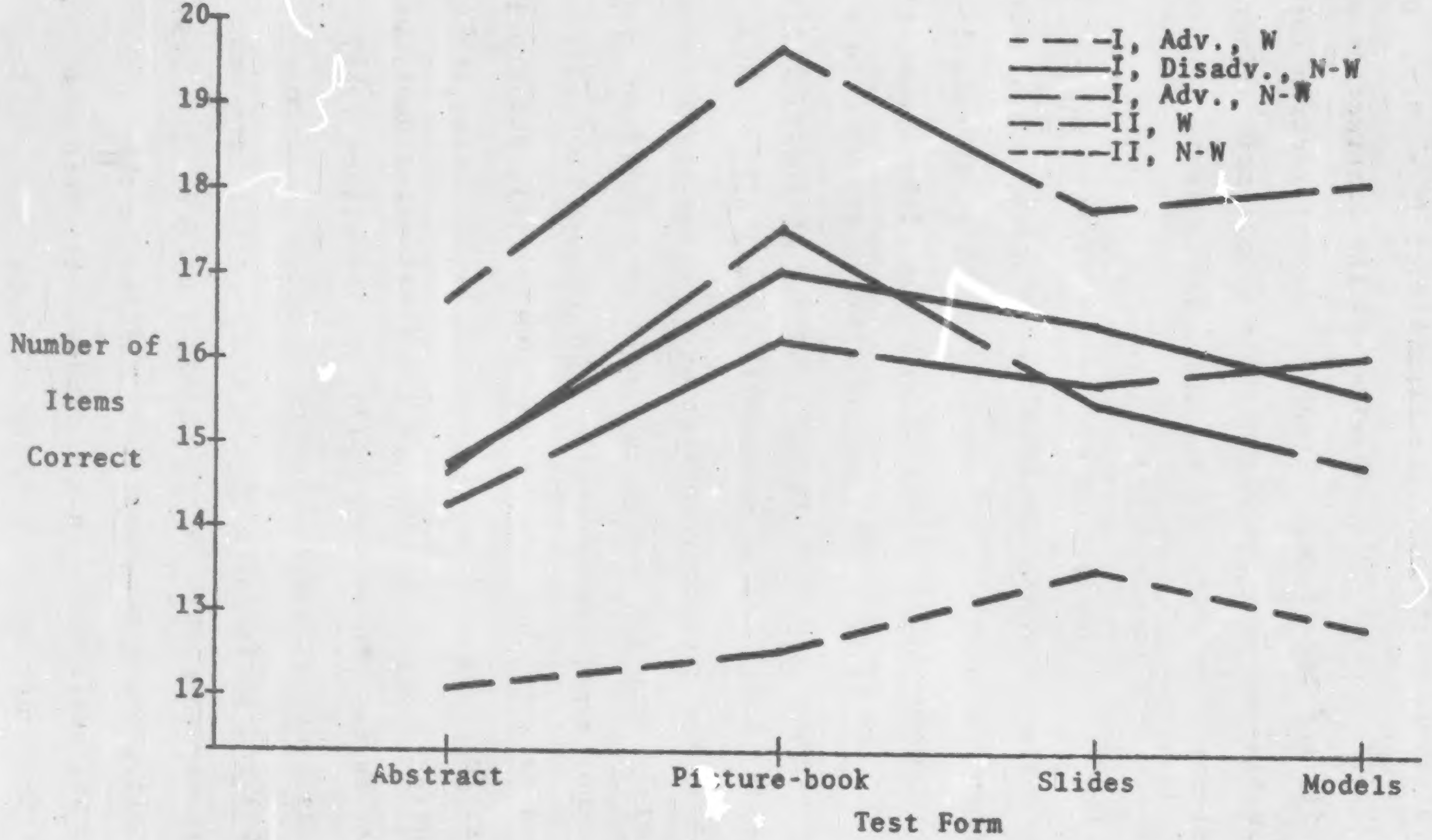


Figure 3
Performance of White and Non-White Children
on Each Test Form in Both Experiments

ethnicity, and test form were significant ($p < .01$). Of primary interest in this analysis was the interaction of ethnicity and test form. Although this interaction in both experiments was not significant, the simple main effects of test form for white and non-white students in each experiment were computed and the results presented in Table 18. Each simple main effect was significant and the Newman-Keuls procedure revealed the following significant differences between means: among the white students in the first experiment, performance on the picture-book (II) form was greater than that on the stories (I) form ($p < .05$); among the white students in the second experiment, performance on the models (IV), slides (III), and picture-book (II) forms was greater than that on the stories (I) form ($p < .01$); among the non-white, advantaged children in the first experiment, performance on the picture-book (II) form was greater than that on the models (IV), and stories (I) test forms ($p < .05, .01$, respectively); among the non-white, disadvantaged children in the first experiment, performance on the picture-book (II) and the slides (III) forms was greater than that on the stories (I) form ($p < .01$) and performance on the slides (III) form was also greater than that on the models (IV) form ($p < .05$); and finally, among the non-white children in the second experiment, performance on the slides (III) form was greater than that on the stories (I) form ($p < .05$).

Table 18

Simple Main Effects of Test Form for White and Non-White Children in Both Experiments

Experiment I

Source	df	MS	F	p
Non-white, advantaged	3	27.37	3.21	<.05
White, advantaged	3	48.68	5.72	<.01
Error	181	8.52		
Non-white, disadvantaged	3	65.98	6,75	<.01
Error	394	9.82		

Experiment II

Source	df	MS	F	p
Non-white	3	38.04	3.80	<.05
White	3	84.17	8.41	<.01
Error	754	10.01		

Summary of the Results

The major findings of the present experiments may be summarized as follows:

1. In both experiments; fourth-graders outperformed second-graders and advantaged children outperformed disadvantaged children.
2. In both experiments, white children outperformed non-white children. In the first experiment, however, this comparison was made only within the advantaged school.
3. In the first experiment, the slides (III) and picture-book (II) test forms resulted in highest performance, while the abstract stories (I) form resulted in lowest performance. In the second experiment, the models (IV), slides (III), and picture-book (II) forms resulted in equally higher performance than the stories (I) form. These patterns were the same among both advantaged and disadvantaged children.

DISCUSSION

To review, the present experiments were designed to test the following hypotheses:

1) that older children, fourth-graders, would outperform younger children, second-graders, on a problem-solving test;
2) that children from an advantaged background (that is, attending schools which did not meet any of the Federal criteria for Title I funds) would outperform children from a disadvantaged background (that is attending schools which did meet or exceed several of the Federal criteria) on that same problem-solving test;
3) that white children would outperform non-white children on the same test; and
4) that disadvantaged children would score highest on the most concrete form of the inventory while advantaged children's scores on the four test forms would not differ significantly.

Grade and Degree of Disadvantage Differences

With respect to hypotheses 1 and 2, the results of both experiments lend additional support to the importance of age and environment to the development of cognitive abilities. In both experiments, the fourth-graders outperformed the second-graders and the advantaged children outperformed the disadvantaged children. In addition, in both experiments, the interaction of grade by degree of disadvantage was significant. Advantaged fourth-graders always outperformed all other children. Thus, the present results are consistent with the developmental research of Inhelder and Piaget, and the research of many investigators into the effects of social class upon cognitive development. Together, these two factors appear to account for a very sizeable twenty-one to twenty-eight percent of the variance of each experiment.

Differences Due to Test Form

Differences due to the various test forms will be discussed prior to a discussion of the differences due to ethnicity. With respect to hypothesis 4, the main effect of test form in both experiments was significant, but the effects of the various test forms, themselves, was not consistent. In both experiments, the stories (I) form of the test, the most abstract form, resulted in poorest performance, but in the first experiment the models (IV) form of the test, the most concrete form, also resulted in significantly poorer performance than the intermediate test forms, while in the second experiment, the models (IV), slides (III), and picture-book (II) forms all resulted in equally higher performance than the stories (I) form.

Two significant interactions involving test form help to identify the inconsistency of the results: those of grade by test form and grade by degree of disadvantage by test form. In both experiments, in the grade by test form interaction, performance on the models (IV) form exceeded only that of the stories (I) form with one exception: the fourth-graders in the second experiment, whose performance on the models (IV) exceeded the performances of the children on all other forms. In the grade by degree of disadvantage by test form interaction in the second experiment, performance on the models (IV) form exceeded or equalled that of any other form except for disadvantaged second-graders. The Maracuilo-Levin procedures revealed that the effect of the models (IV) with disadvantaged children contributed a significant amount of variation to the interaction effect. Thus, one may conclude that the models (IV) have a significant effect but that effect appears to be detrimental among the disadvantaged, younger children.

It may be helpful at this point to recall the concern expressed by Piaget (1970) that the concreteness of visual learning aids not become an end in itself; that is, it must not be confused with the process of thought--the operations performed on the content of the pictures or models. The pictures and models were supposed to enhance children's (especially disadvantaged children's) performance on an abstract task, the problem-solving test, because the content--the concreteness--of the materials would be closer to the natural representations of thought of the children at their particular stages of development. The underlying assumption was that the closeness to the natural mode of representation of thought would make the operations of thought easier.

That the models did not result in the highest performance levels may be an indication that Piaget's concern was well-founded. The content of the models alone was not sufficient to increase the cognitive operations with the materials on the part of children. One of the reasons for this inability may be that, as with the Cuisenaire Materials, when children are not allowed to manipulate them and make their own discoveries, the increased realism and concreteness adds nothing. Manipulation, in the Piagetian sense, is extremely important (Sigel, 1969) and, since the children in the present experiments were not allowed to handle the models in any way, the models may have been no more effective than the slides or picture-book forms. The question of manipulation is therefore one area of necessary future work.

On the other hand, the extra details of three-dimensionality and color may have actually interfered with the performance of some children. Travers (1967) and Dwyer (1967, 1970) demonstrated that more "realistic" learning aids, in general, do not enhance performance. Gibson (1954) pointed out that if the task to be learned requires the discrimination or identification of significant details in the displays, then too many cues may interfere with the child's ability to identify the relevant ones. The Purdue Inventory does require children to notice details in scenes and make generalizations about them (Feldhusen, et al., 1972; Speedie, et al., in press), but the color and three-dimensionality are not crucial or necessary to the solution of any of the problems. Thus, they were irrelevant to the final task, as in Sigel's (1954) research, but they may have made the job of locating the relevant details more difficult.

Furthermore, the apparent finding that the models hurt the performance of younger children and disadvantaged children most lends additional support to Rohwer's (1970) contention that the language accompanying an image is also important. He pointed out that the paired-associates task involves a considerable amount of conceptual activity: in particular, "the construction of images depicting episodes involving the two members of each pair and the formation of sentences describing possible episodes involving the pair members (Rohwer, 1971, p. 201)." This model may be applied to the tasks required of children in the problem-solving test in the present experiments. Children are asked to form a number of associations between the image (the picture, the slide, or the model) and the accompanying verbal description and then evaluate (i.e. manipulate, or transform, in the case of redefinition items, for example; Speedie, et al., in press) the alternatives provided according to the associations previously formed between the image and the narrative. He suggests that children are able to use images effectively only when they are accompanied by some verbal representation, and that older children should be more likely to use images spontaneously than younger children. Thus, the older, advantaged children may have been better "equipped" to handle the most "realistic" test form.

Differences Due to Ethnicity

The question of verbal representation, or language, is also important because the language used on the forms of the Purdue Problem Solving Inventory cannot be considered entirely "culture-free," even though a special effort was made to reduce cultural bias in developing it. Specifically, the language on the inventory is Standard English. Significant research with language differences between white and non-white cultures indicates that there are distinct dialects and that children familiar with one are not able to operate effectively with the other without special training (Baratz, 1969; Rystrum, 1969). The Purdue Inventory, while making use of pictures and models, does present a considerable amount of verbal material. Although all of the verbal item descriptions, directions, and alternatives are presented on tape to minimize reading difficulties, the use of Standard English may have made more difficult for non-white children the interpretation of that language with respect to the content of the images provided or, in the case of the all-verbal form, with respect to the creation and manipulation of the children's own images. In both experiments the effect of ethnicity accounted for approximately ten percent of the total variance. (It should be recalled that the analysis of ethnicity in the first experiment involved only advantaged children.) Whites always outperformed non-whites. In addition, in the second experiment, a significant degree of disadvantage by ethnicity interaction was obtained. In this interaction the means of advantaged and disadvantaged white children differed significantly from each other and from those of non-white children, but the means of the advantaged and disadvantaged non-white children did not differ significantly. Thus, the language used on all forms of the problem-solving test may have biased the test in favor of white children. This is a second area of necessary future research.

Another interesting pattern of results was obtained, however, concerning the effects of ethnicity. It should be recalled that the disadvantaged children in the first experiment were all non-white; thus, the models (IV) form, in actuality, resulted in a decrement in the performance of non-white second-graders in the first experiment. The results of the simple main effects of test form for white and non-white students in both experiments indicated that the performance of the white children on the models (IV) form was always greater than that on the slides (III) and picture-book (II) forms, but that of the non-white children was lower in comparison. In other words, the models (IV) resulted in a decrement in performance among the non-white children, which was largest among the second-graders.

This result is indeed surprising, since an obvious difference between the models (IV) form of the test and the slides (III) or picture-book (II) forms is the extensive full-color, multi-ethnic illustrations. To be consistent with a developmental theory, one may propose that the additional details of three-dimensionality and color in the models, irrelevant to the actual problem-solving task, placed additional strain on the already "underdeveloped" perceptual or cognitive skills of minority-group children. However, in the second experiment, non-white children of advantaged status were involved as subjects and these differences were not so pronounced.

Another possible explanation is that the additional details of color and three-dimensionality resulted not in greater cognitive, but rather affective, involvement. In other words, the sight of so many non-white children in the models may have been such a novel and motivating stimulus to the non-white children that their performance on the problem-solving task, itself, was affected negatively.

Little research exists on the use of ethnic illustrations in learning materials (Litcher & Johnson, 1969; Whipple, 1964; Niemeyer, 1965) but the work that has been done has demonstrated both cognitive and affective effects of such materials. The use of color, itself, as a variable in learning materials has been shown to be an effective tool for increasing both learning and interest or attention (Dooley & Harkins, 1970). Thus, a third area of necessary future research is the effect of the multi-ethnic illustrations in the problem-solving test.

Additional Considerations

It has been suggested in previous sections that the children may have to actively handle or manipulate the models before the additional concreteness can enhance the cognitive operations involved in the problem-solving task. The details of color and three-dimensionality, irrelevant to the final task, may have made the job of isolating the relevant details of the problem situations more difficult. The language used on the four test forms has also been identified as a possible source of bias against disadvantaged and non-white children. However, other factors may have also influenced the results of the present experiments.

One possible factor which may have contributed to the differences in results between Experiments I and II and from the experimental hypotheses may be that the tests were not sufficiently reliable. The only data available on the 25-item test forms are for advantaged children. The test-retest reliability of .70 for the abstract form, and .69 for the slide form are moderately good at best. Estimates of reliabilities (KR-20's) for all of the test forms from Experiments I and II do demonstrate some consistency in both experiments (see Table 5). However, no test-retest data is available for disadvantaged students or for the picture-book and the models forms of the test. This is a fourth area of needed future research.

It should also be recalled that the samples used in both experiments differed significantly from each other. The grand mean of children in the second experiment was significantly lower than that of the children in the first experiment. Both schools used in the first experiment failed to meet the criteria for the disadvantaged category while three schools used in the second experiment did meet several of the criteria. The higher level of performance by the children in the first experiment may have, therefore, masked some of the differences due to test form.

Another explanation which may help explain the poor performance of the children on the models (IV) may be that the four test forms did not differ significantly enough on the continuum of abstractness to concreteness. The classification of visual experiences proposed by Edling (1966) includes a number of audio-visual aids other than cartoons. His classification includes motion pictures, still pictures, paintings, photographs, sketches, in that order, in addition to cartoons, which are the least "realistic" in that scheme. By the same token, models is the least realistic class among authentic situations, socio-drama, pageants, pantomime, tableau, puppets, debate, demonstration, objects, and models. Thus, the models (IV), slides (III), and picture-book (II) forms may have resulted in similar performance because they were too close together on the proposed continuum. The coefficient of equivalence between the models-slides and the models-picture-book forms were .73 and .83, respectively. Thus, this possibility is a real one and suggests that, in the future, the test forms be constructed further apart along the continuum from each other.

Summary

Four forms of the Purdue Problem Solving Inventory were developed. They were designed to form a contimuum of realism in terms of the representation of the items, themselves. One form involved the use of three-dimensional, full-color models of problem situations (IV), a second form used black and white line drawings of the same scenes presented as slides (III), a third form used the drawings printed in a test booklet (II), and a fourth form presented all-verbal descriptions of the scenes without any form of picture at all (I).

The four forms were administered to two samples of second- and fourth-graders from several schools in Indianapolis, Indiana. Schools were selected so that equal proportions of advantaged and disadvantaged children were involved.

The results of the present experiments were discussed in terms of four experimental hypotheses. First, as predicted, older children outperformed younger children. Second, children from an advantaged background outperformed children from a disadvantaged background. These two results were consistent with extensive research in the area of the development of cognitive abilities. The factors of grade and socio-economic status have been shown to effect performance significantly on a number of verbal and conceptual skills.

With respect to the third hypothesis, white students outperformed non-white students. In both experiments, almost ten percent of the variance was accounted for by the factor of ethnicity. In this connection, a model proposed by Rohwer was discussed. Task requirements on the Purdue Inventory may be similar to those of the paired-associates task. With this task, Rohwer has found that the nature of the verbal representation accompanying the image is as important as the "realism" or concreteness of the image, itself. In the case of the Purdue Inventory, the language used was that of Standard English, which may have hindered the ability of the non-white children to operate effectively with the images provided or their ability to create their own images.

It was also noted that the effect of ethnicity manifested itself in terms of a different pattern of performance on the four test forms. Specifically, the performance of non-white children decreased on the models (IV) form compared to that of the slides (III) but that of the white children in the same comparison increased. It was proposed that the multi-ethnic illustrations in the models may have negatively influenced the performance of non-white children by increasing their affective involvement.

In terms of the fourth hypothesis, children given some form of image to accompany the verbal description on the problem-solving test outperformed children only given verbal descriptions of the problem scenes. On the other hand, the most realistic form of the test, the models (IV), did not consistently result in the highest performance. It may have been that the additional details of color and three-dimensionality added nothing in the way of relevant information and may have made the job of isolating the relevant from the irrelevant information more difficult, or it may have been that the effect of concreteness was lost because children were not allowed to actively manipulate the models.

Other factors which may have contributed to the difference in results between Experiments I and II were also discussed: the lack of sufficient information concerning the reliability of the four test forms, the difference between the subject samples in the two experiments, and the sufficiency of distinctiveness of the four test forms from each other on a continuum of concreteness or realism.

Several areas of needed future research were pointed out: the effects of multi-ethnic illustrations upon the affective and cognitive involvement of children, the use of standard versus non-standard dialects in the verbal narrative on the problem-solving test, the reliability of the instruments, especially the models (IV) test form, and the possible need for children to actually handle the models.

CHAPTER V

Conclusions of Both the Concept Formation and Problem Solving Experiments

1. The factors of grade and SES in both experiments proved to be significant in the present experiments, thus demonstrating the importance once again of maturational and environmental factors, and their interaction, in the development of cognitive abilities.
2. The addition of a greater degree of concreteness or realism in the mode of presentation of test stimuli does affect the performance of second and fourth grade children. The effect of concreteness manifested itself in different ways for the concept formation and problem solving tests, however. In the case of the concept formation test, significant interactions were obtained between the factors of SES and Test Mode on conservation problems. Disadvantaged children outperformed advantaged children on only the most concrete test form. On the problem-solving tests, however, no SES by Mode interactions were obtained, but the main effect of Mode was significant. Both advantaged and disadvantaged children performed best, but differences between advantaged and disadvantaged children persisted, on the more concrete forms of the problem-solving inventory.
3. The results of the present studies have generated additional questions. First, since children were never allowed to manipulate any of the "manipulable" concrete test forms, the value of these new forms may not have been fully explored. The results of both

experiments demonstrated very similar performance levels on the picture, slide and/or film, and model or actual-object forms. Thus, the lack of manipulation on the part of Ss may have reduced the real difference between the forms. Second, the difference in results between problem-solving and concept formation tests points to the need for more examination of the differences between these abilities or skills. While both instruments have undergone considerable development, they must still be considered experimental instruments. Only preliminary work has been completed which attempts to analyze the specific abilities required to perform satisfactorily on the tests. In the case of the concept formation test, differences in results were obtained on the two types of items. Obviously, the nature of the different abilities involved on the tests and their relation to the characteristics of advantaged and disadvantaged pupils need to be researched before global statements about problem-solving and concept formation can be made.

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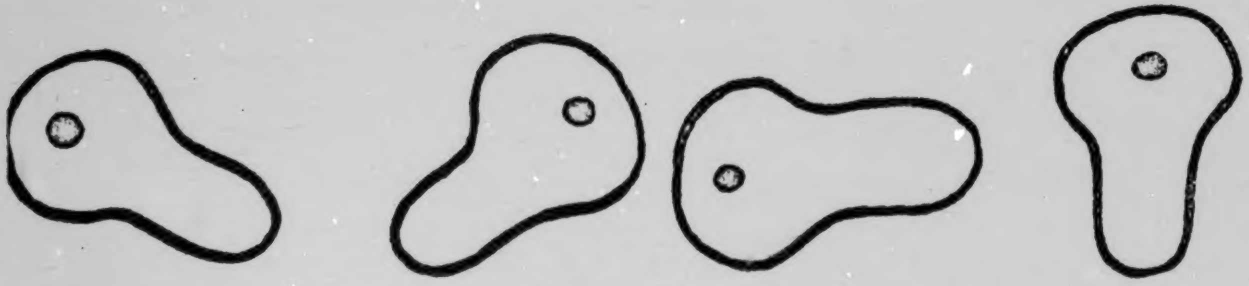
APPENDIX I

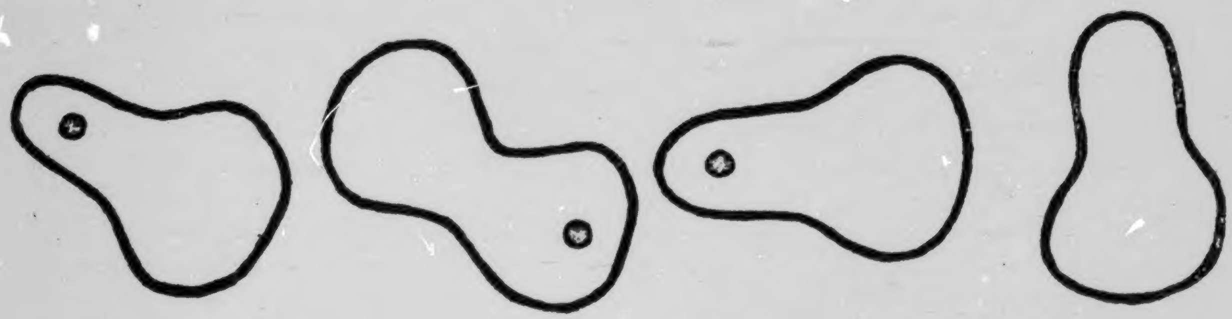
CONCEPT FORMATION TESTS

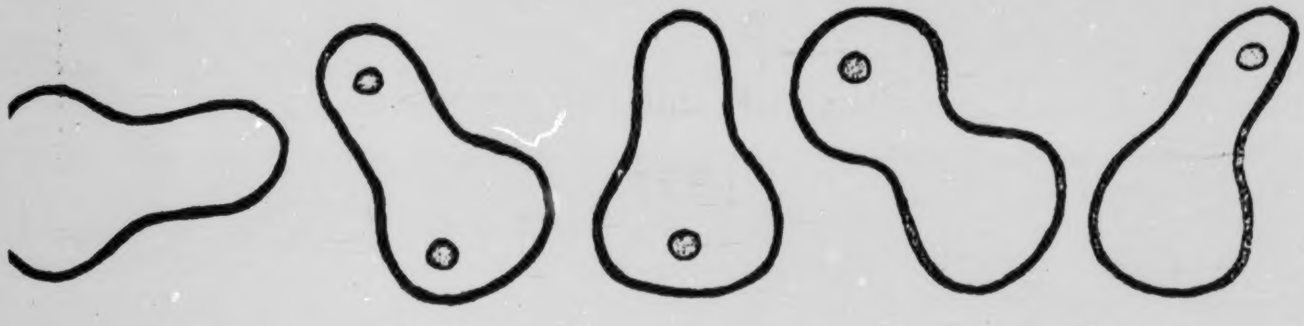
MY
NAME IS

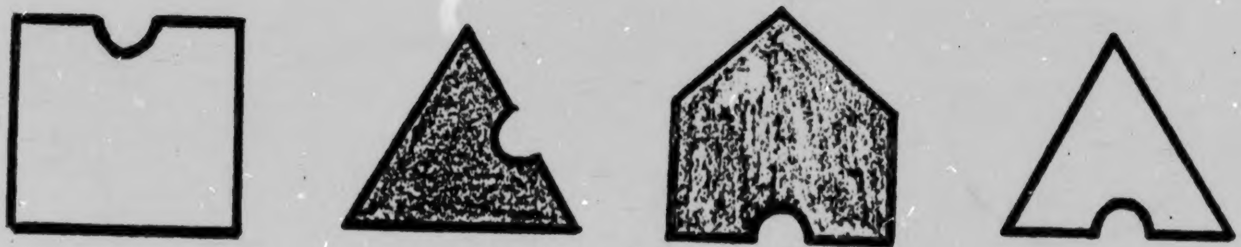
____

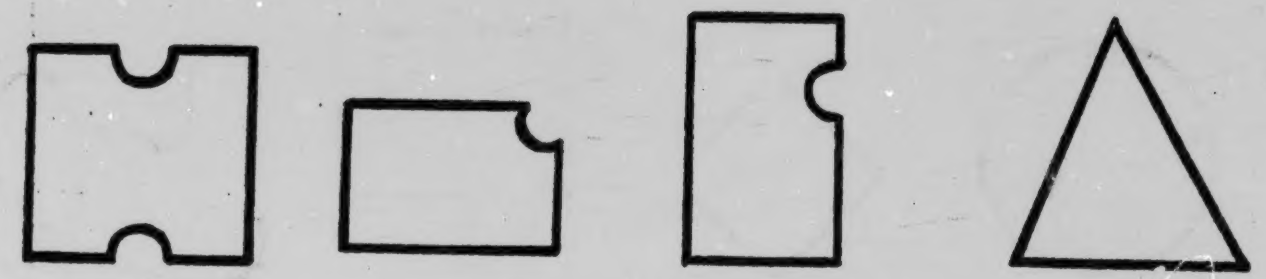
PURDUE UNIVERSITY
1971

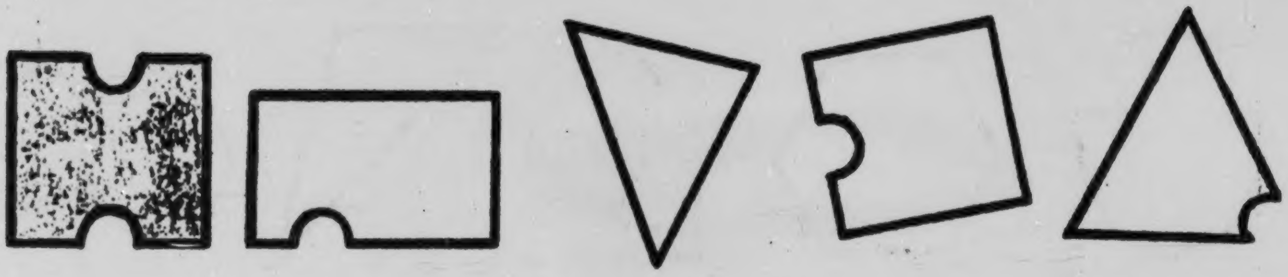


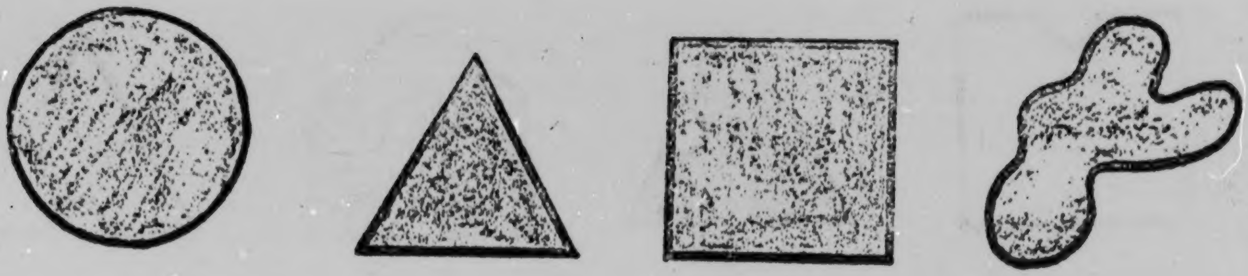


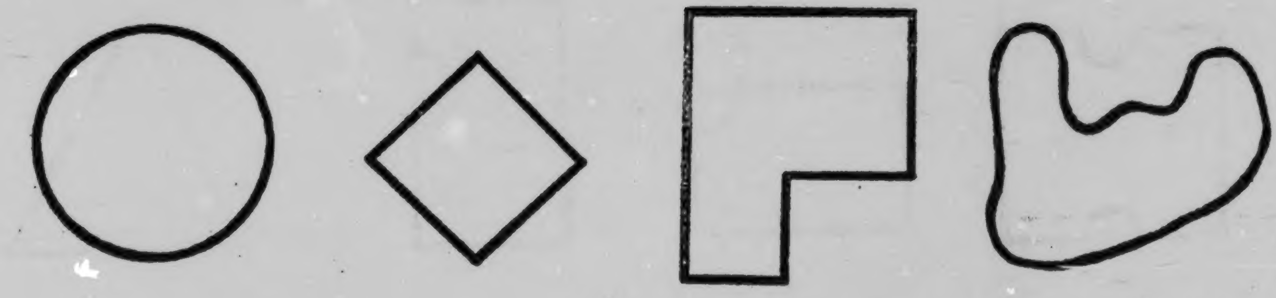


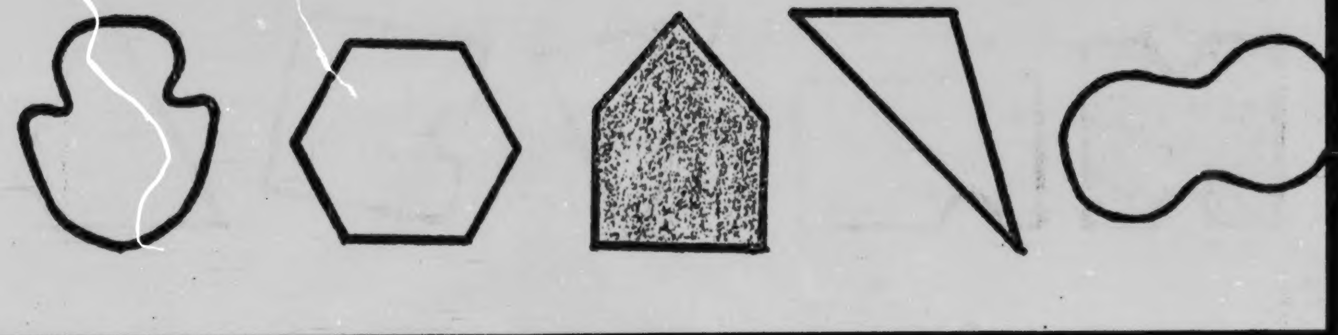


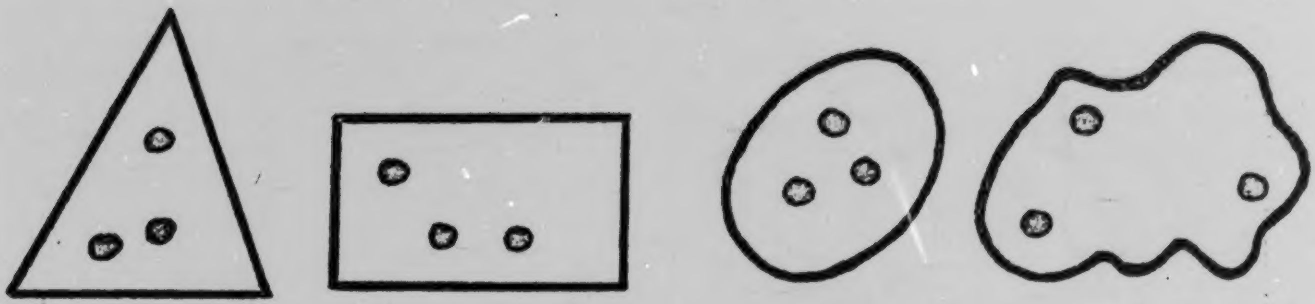


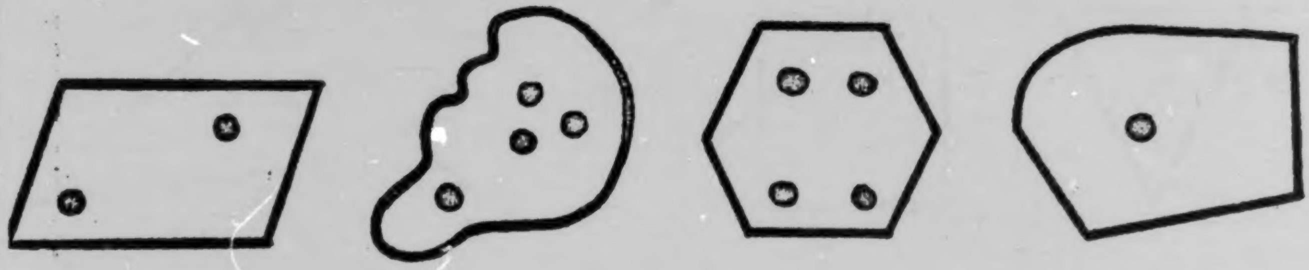


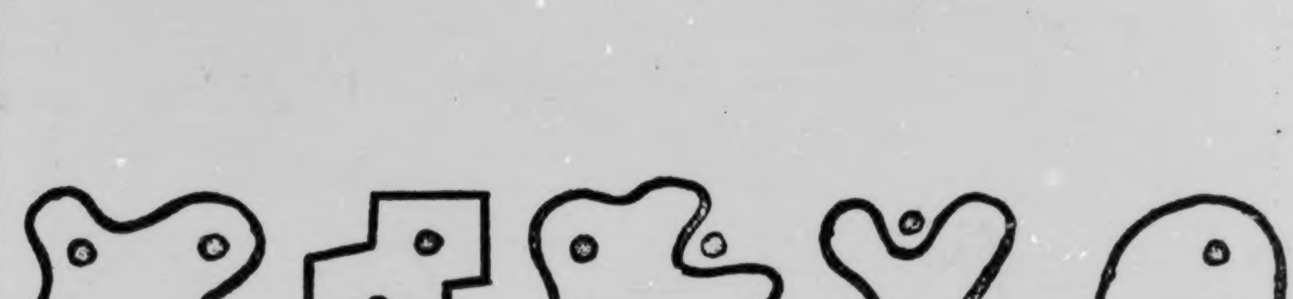


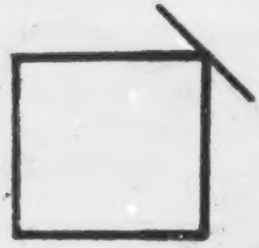
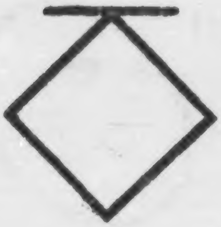
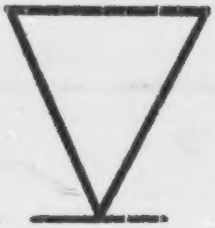
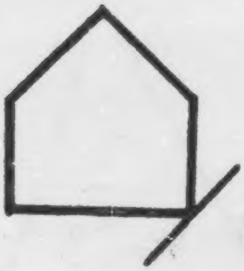


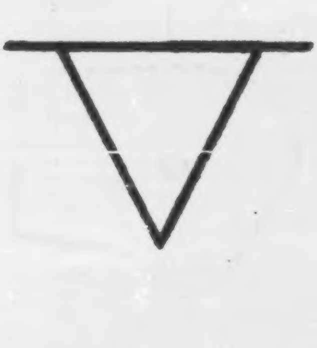
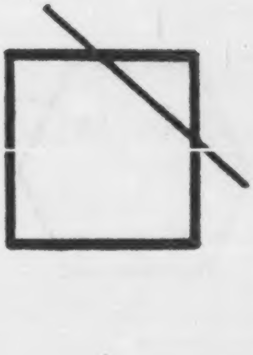
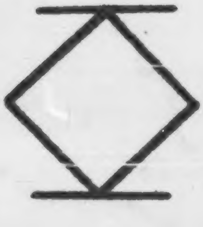
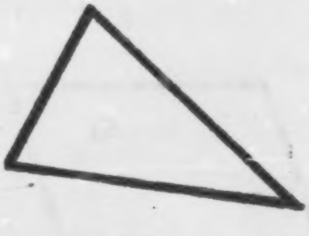


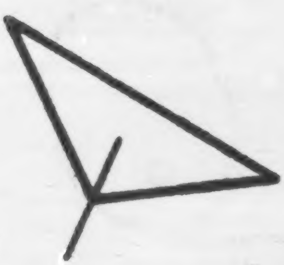
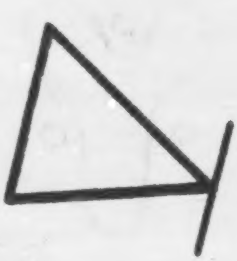
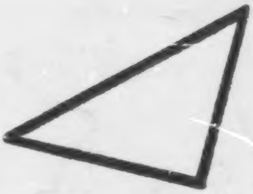
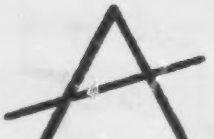
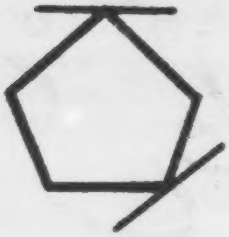


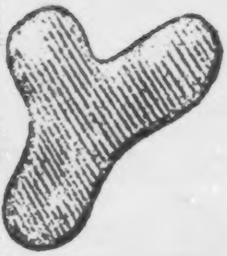
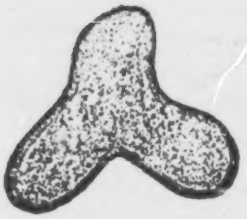
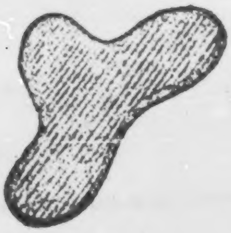
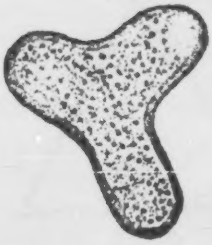
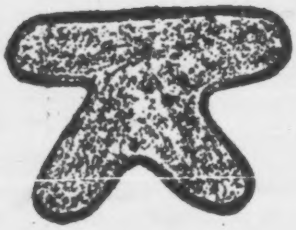
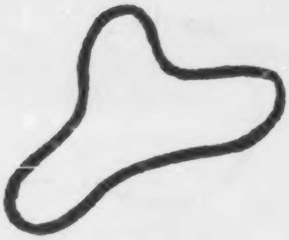
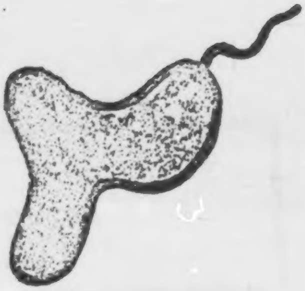
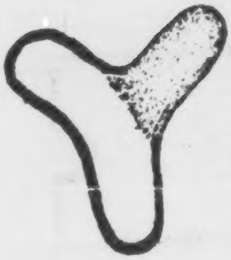
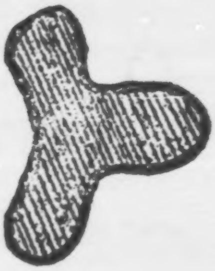
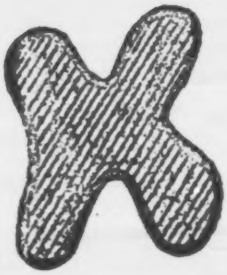
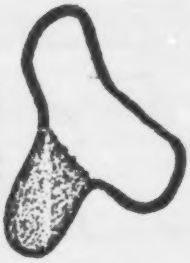
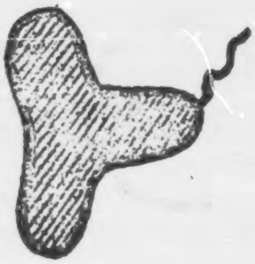
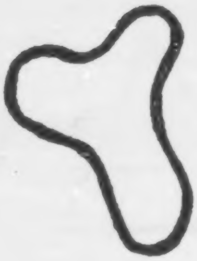


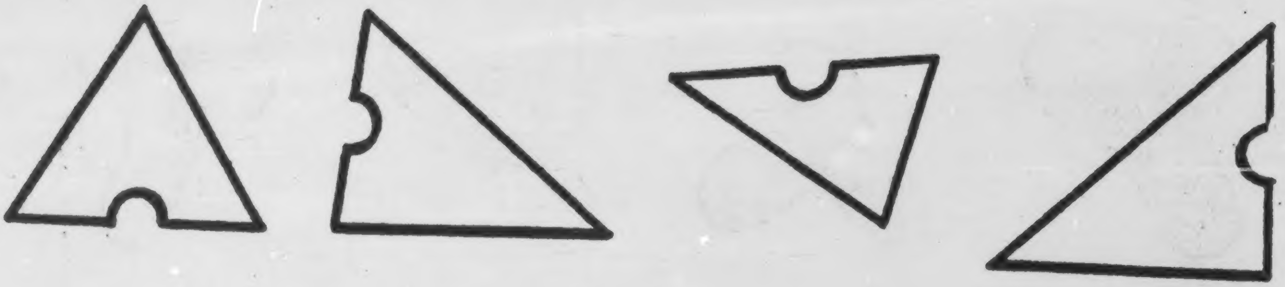


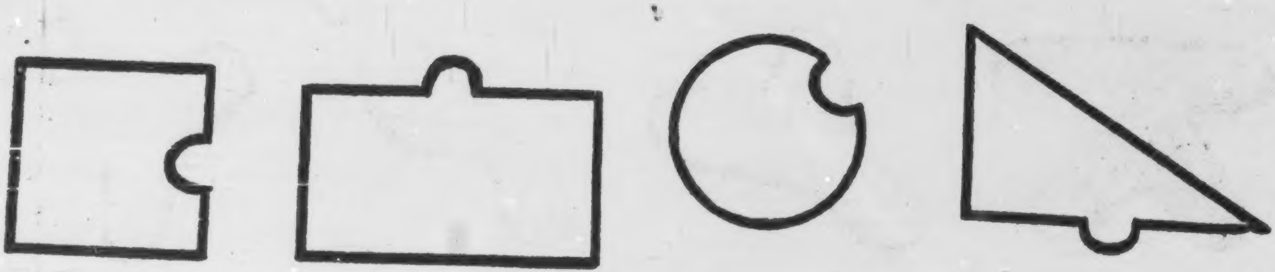





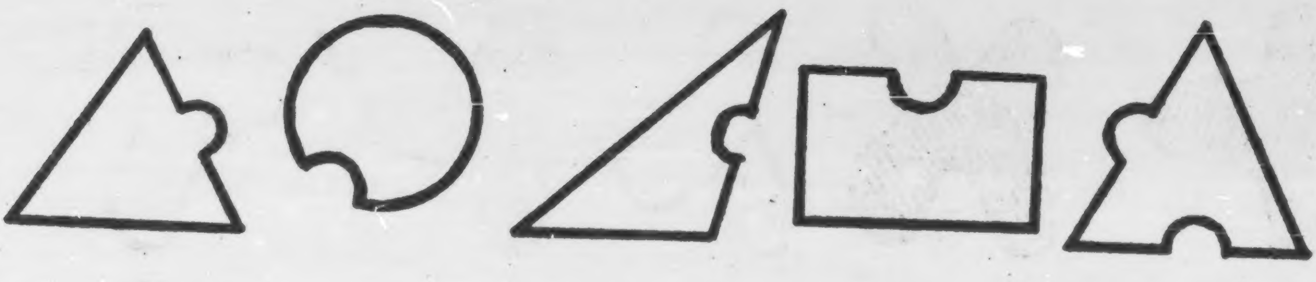





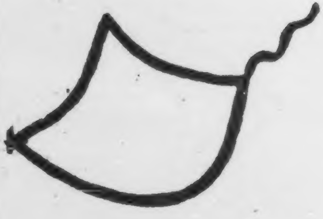






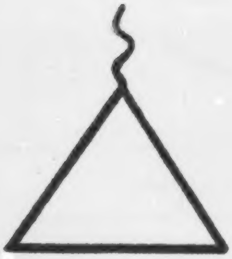














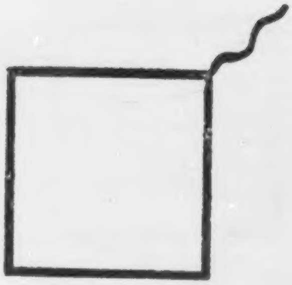


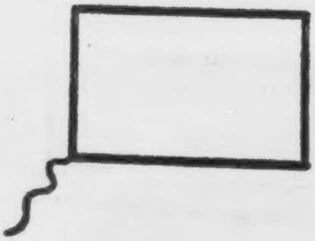


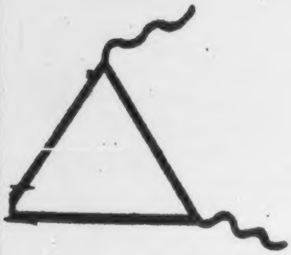


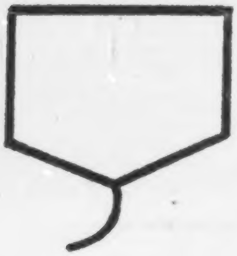


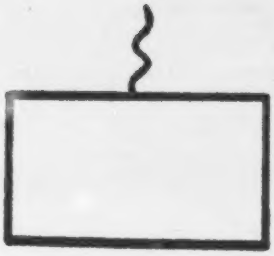


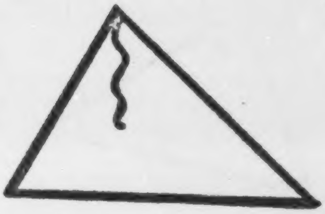


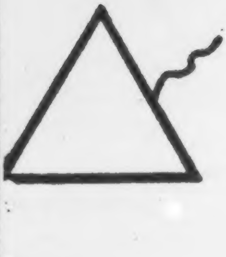


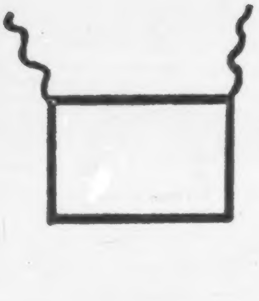


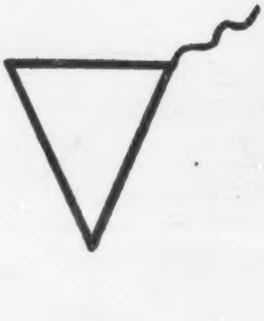


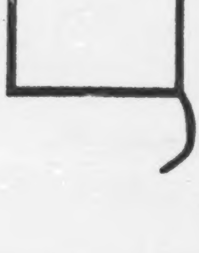


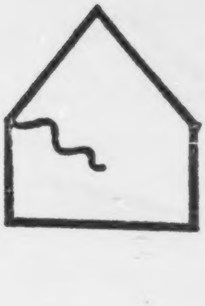


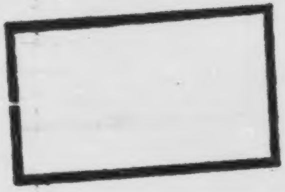
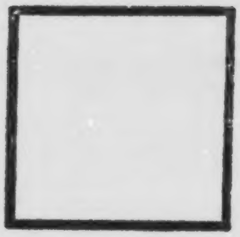
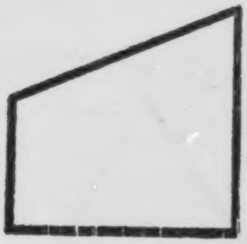
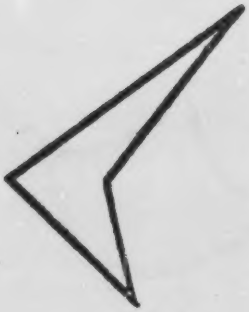
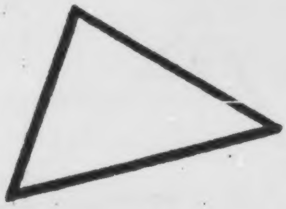
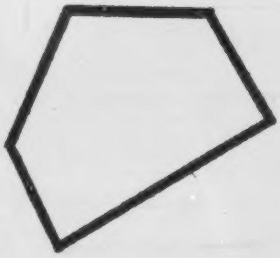
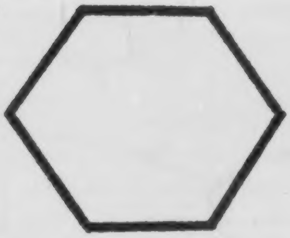
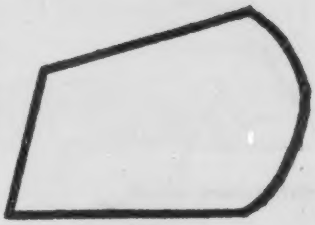
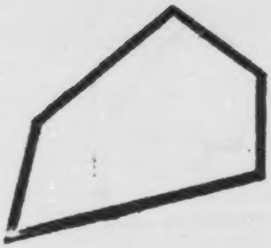
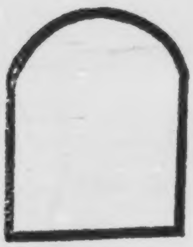
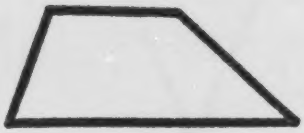
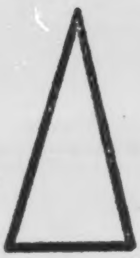
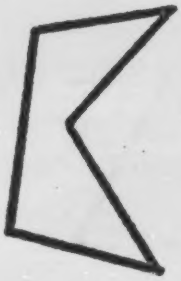


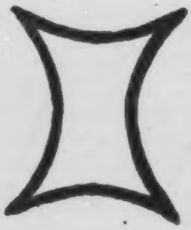


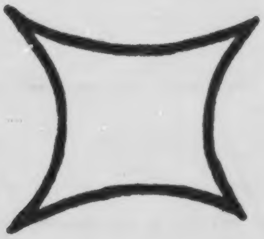


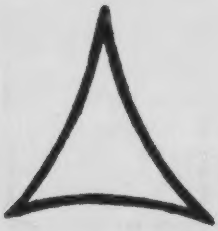


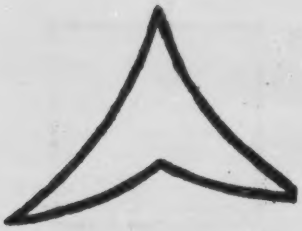


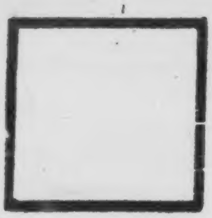














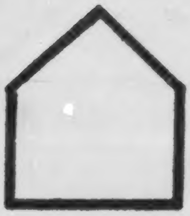


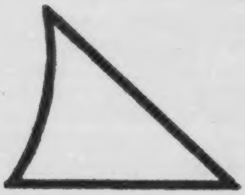


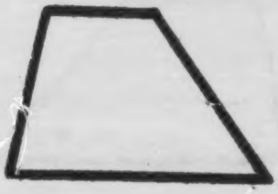


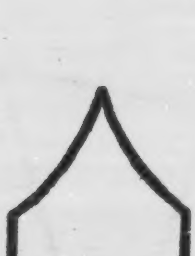


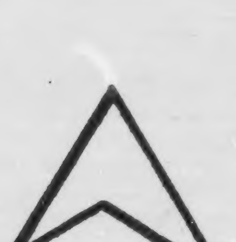


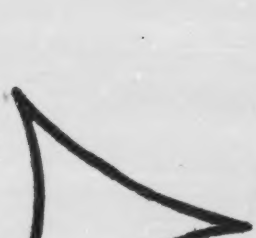


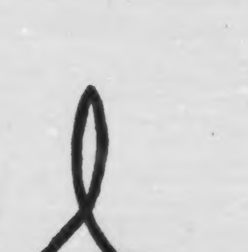


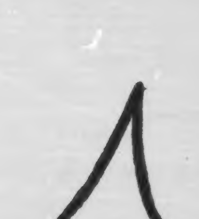


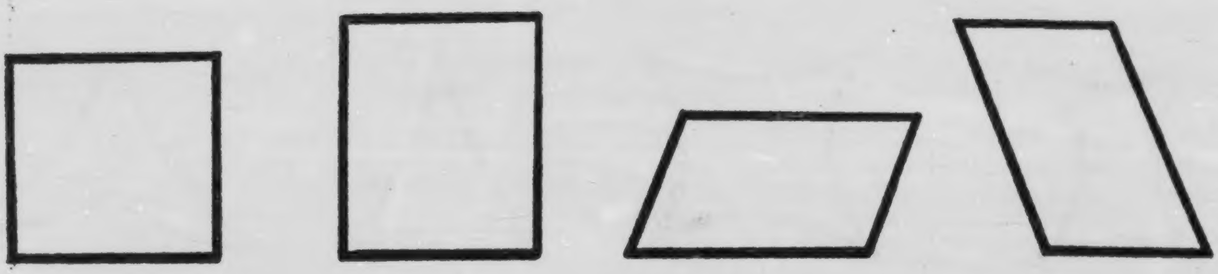


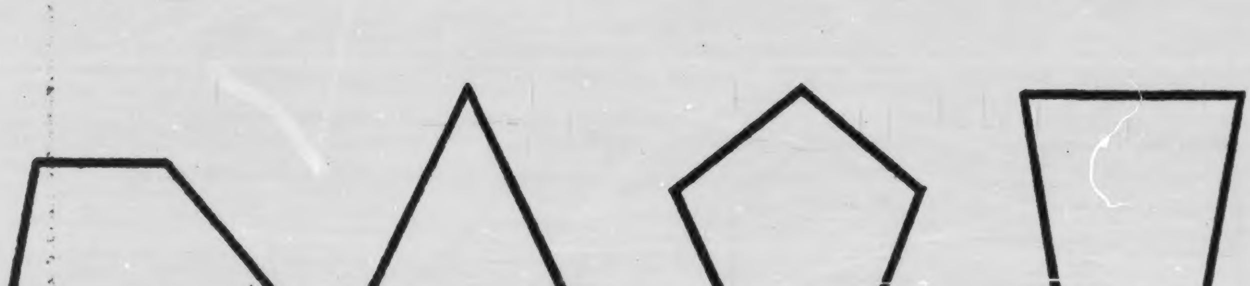


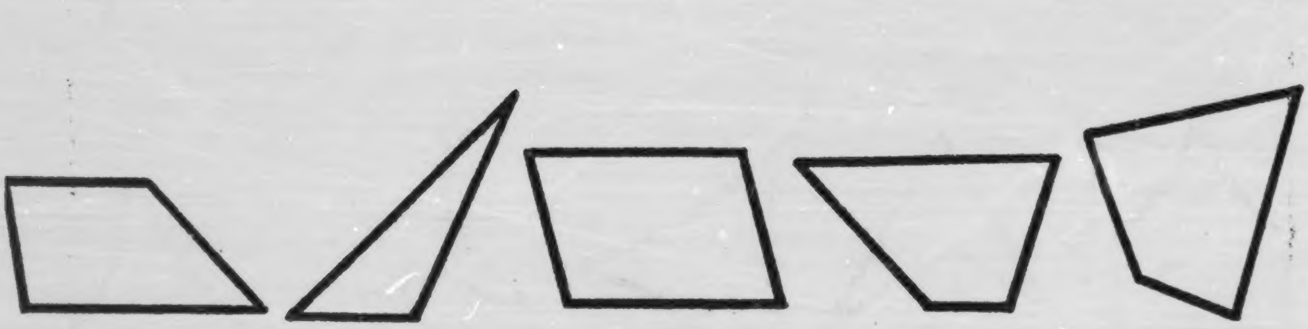


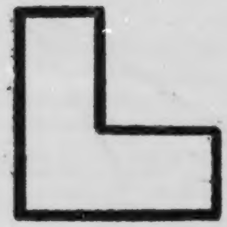
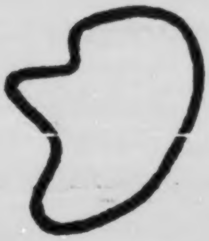
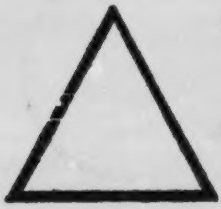
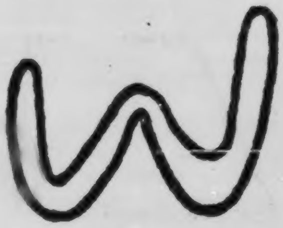
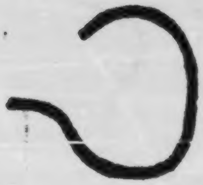
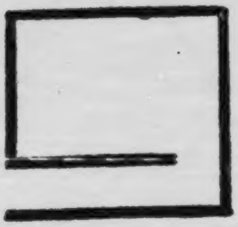
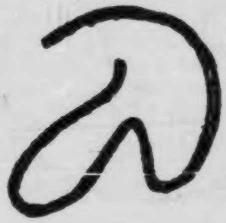
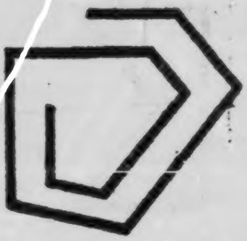
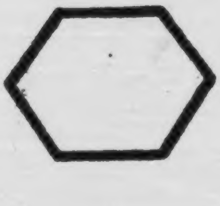
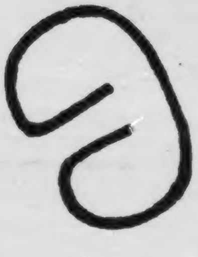
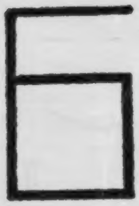
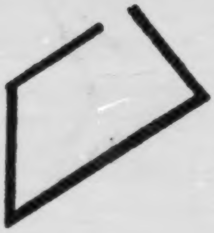
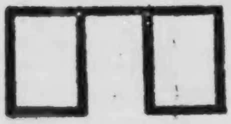


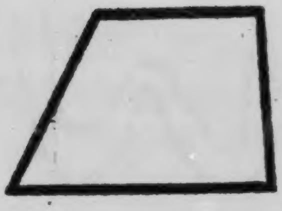


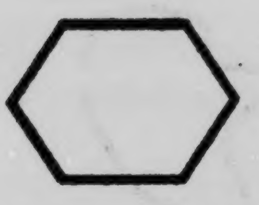
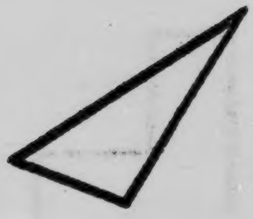
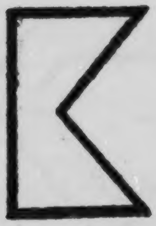
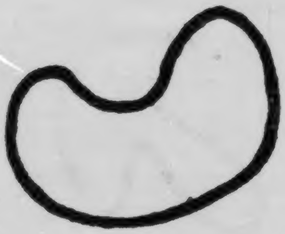
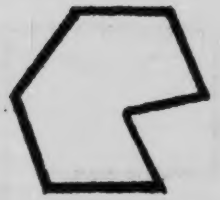
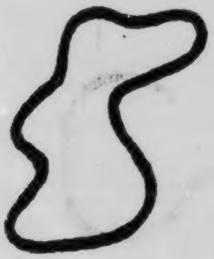
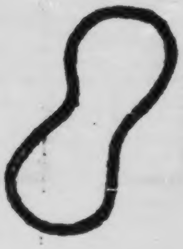
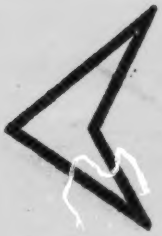
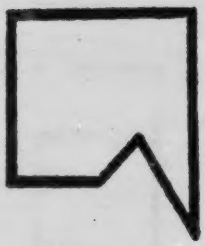
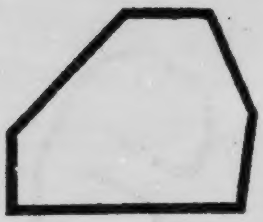
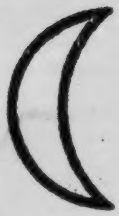


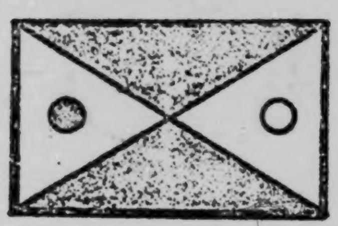
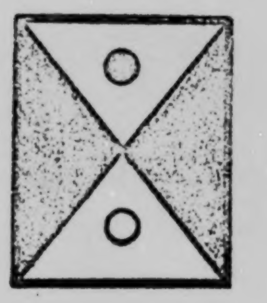
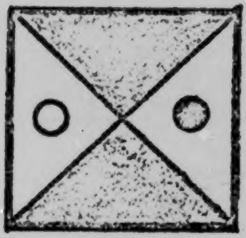
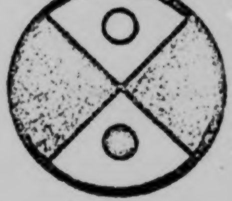


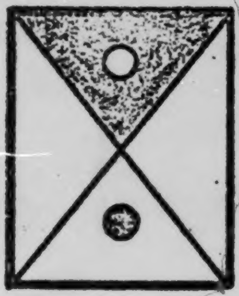
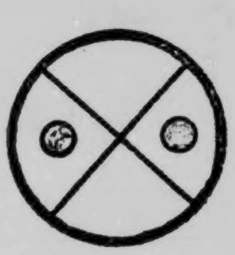
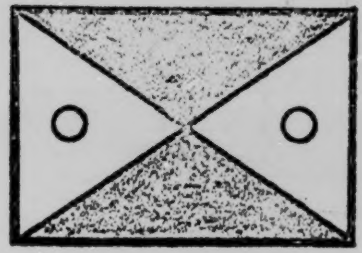
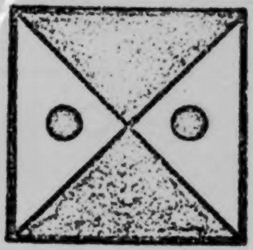


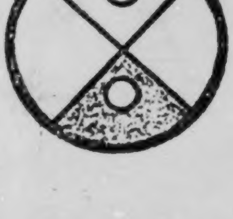
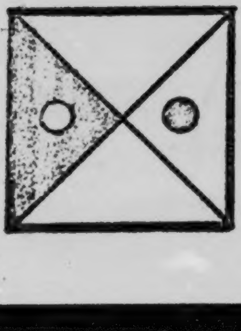
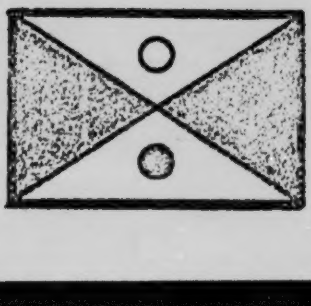
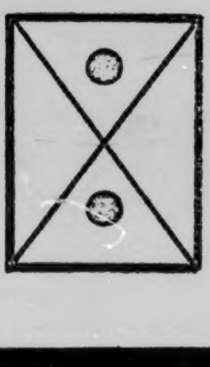
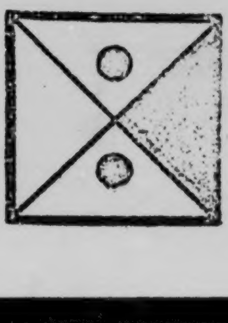














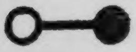


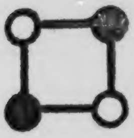












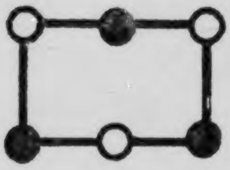





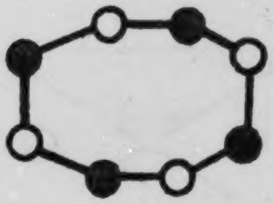





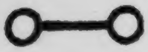






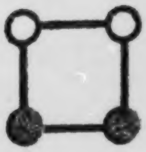


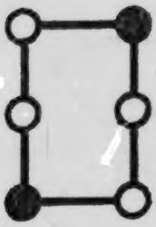


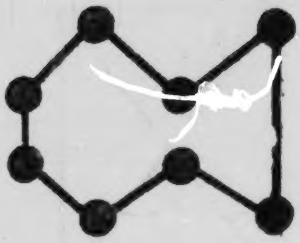


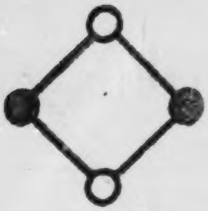


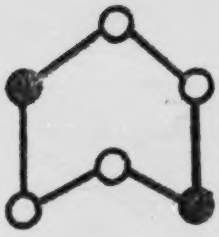


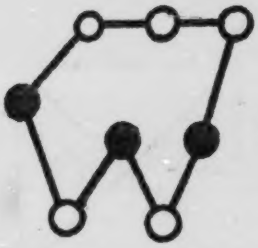


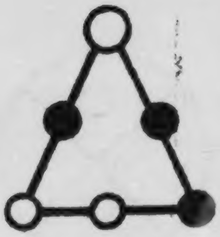






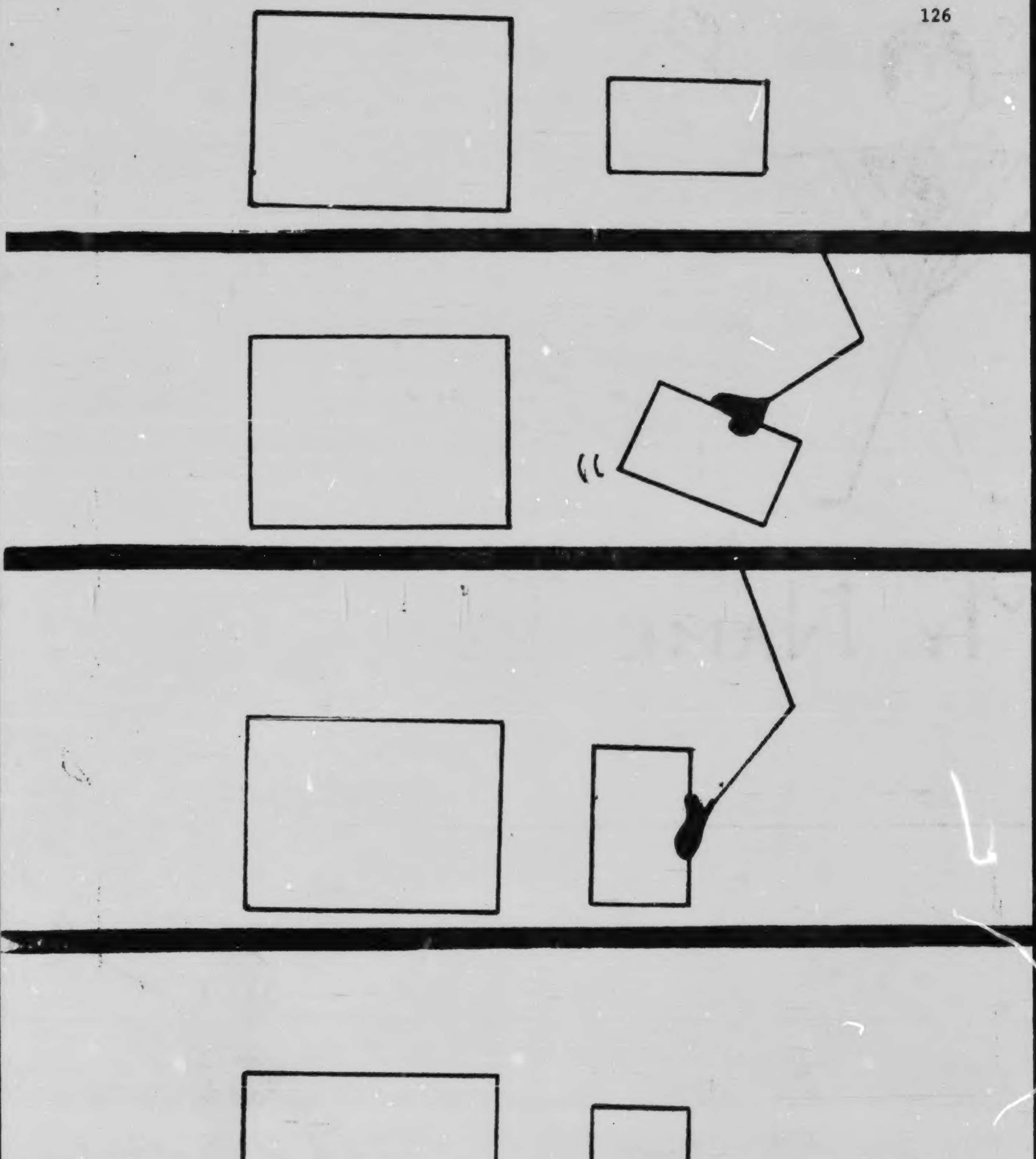


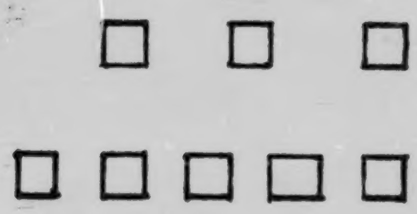


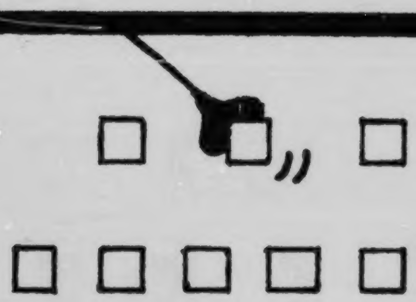


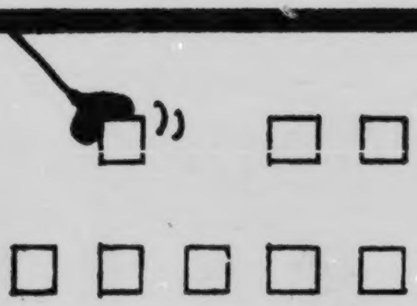
MY NAME IS

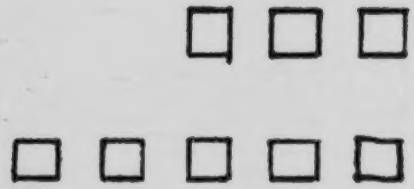
____

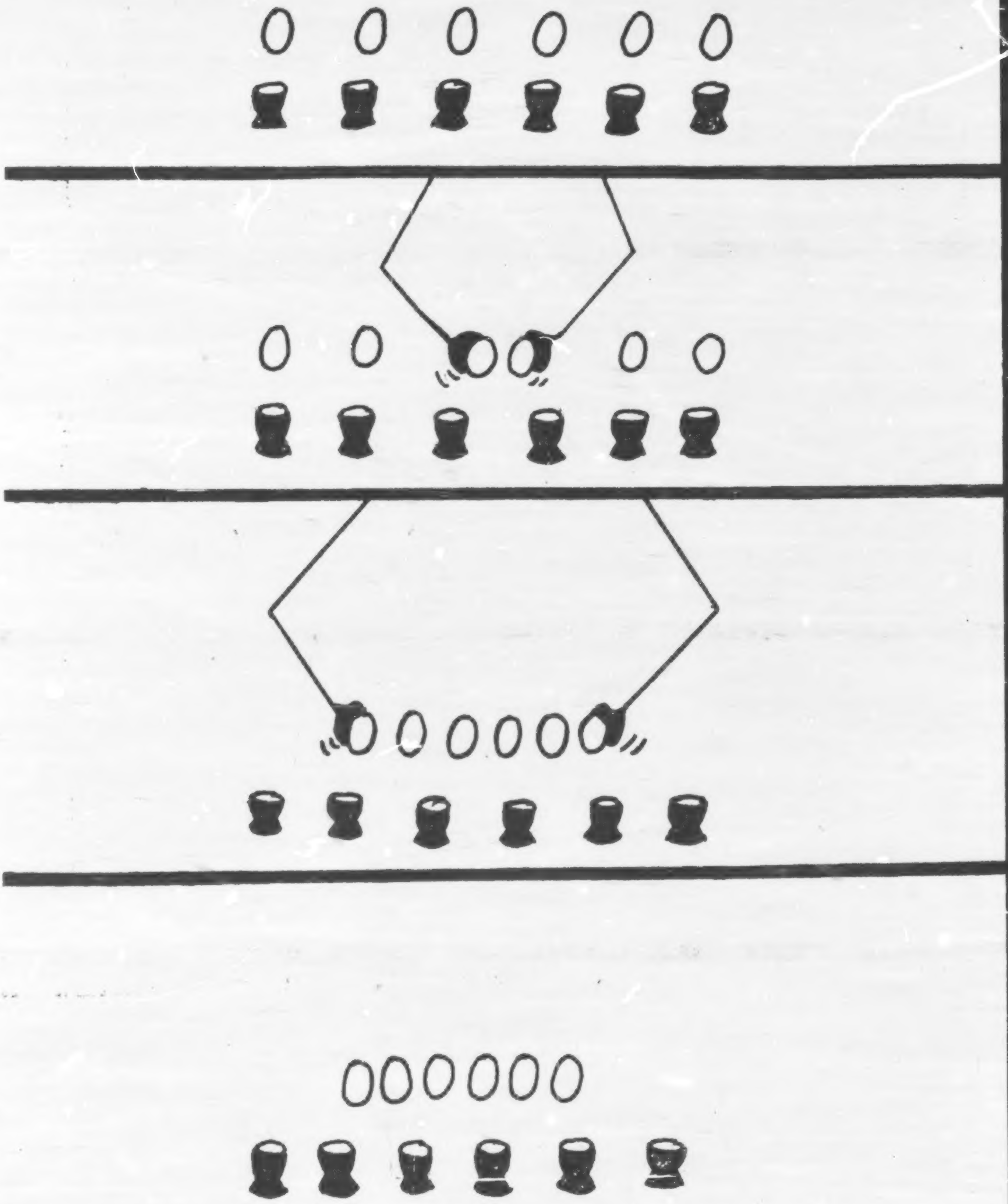


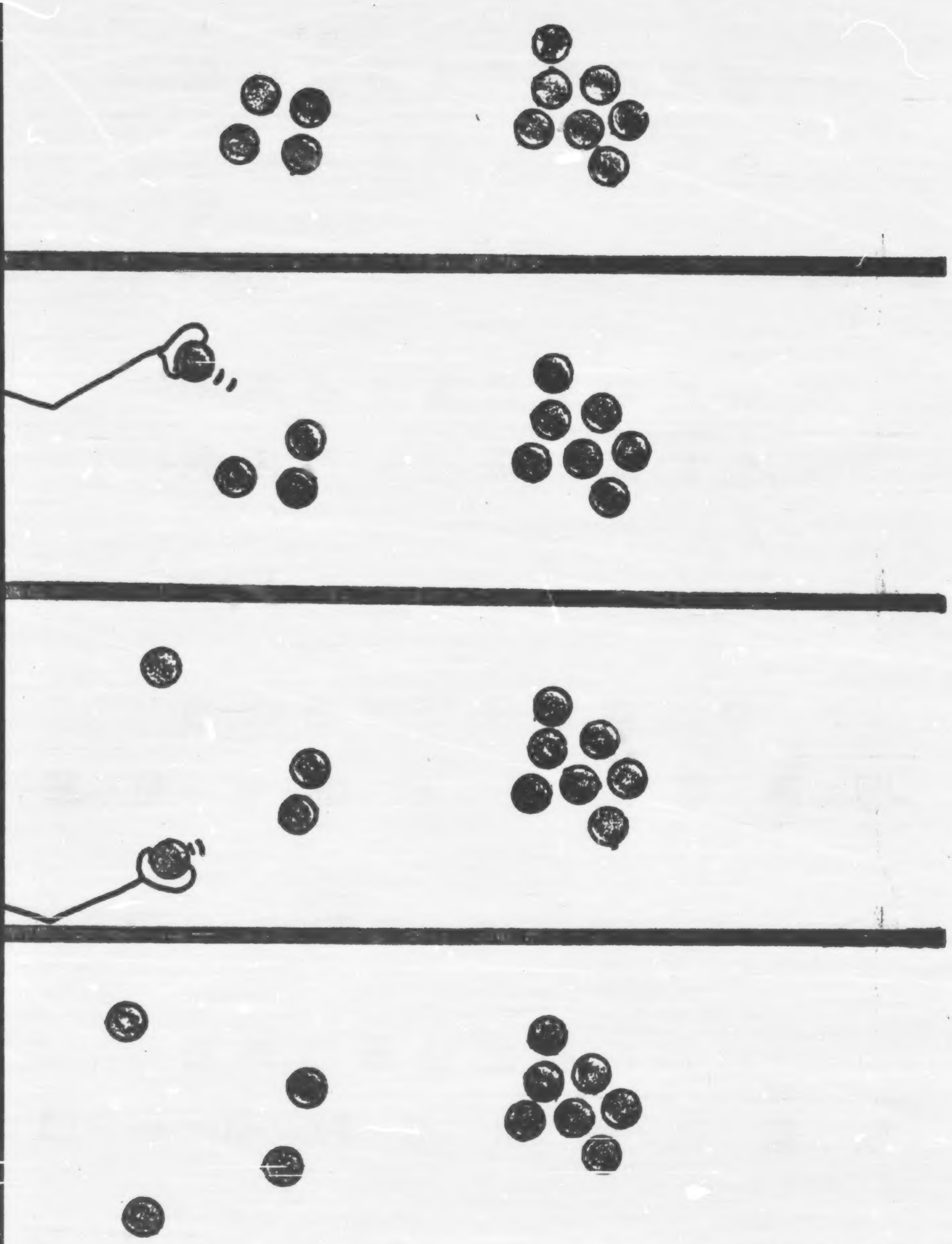


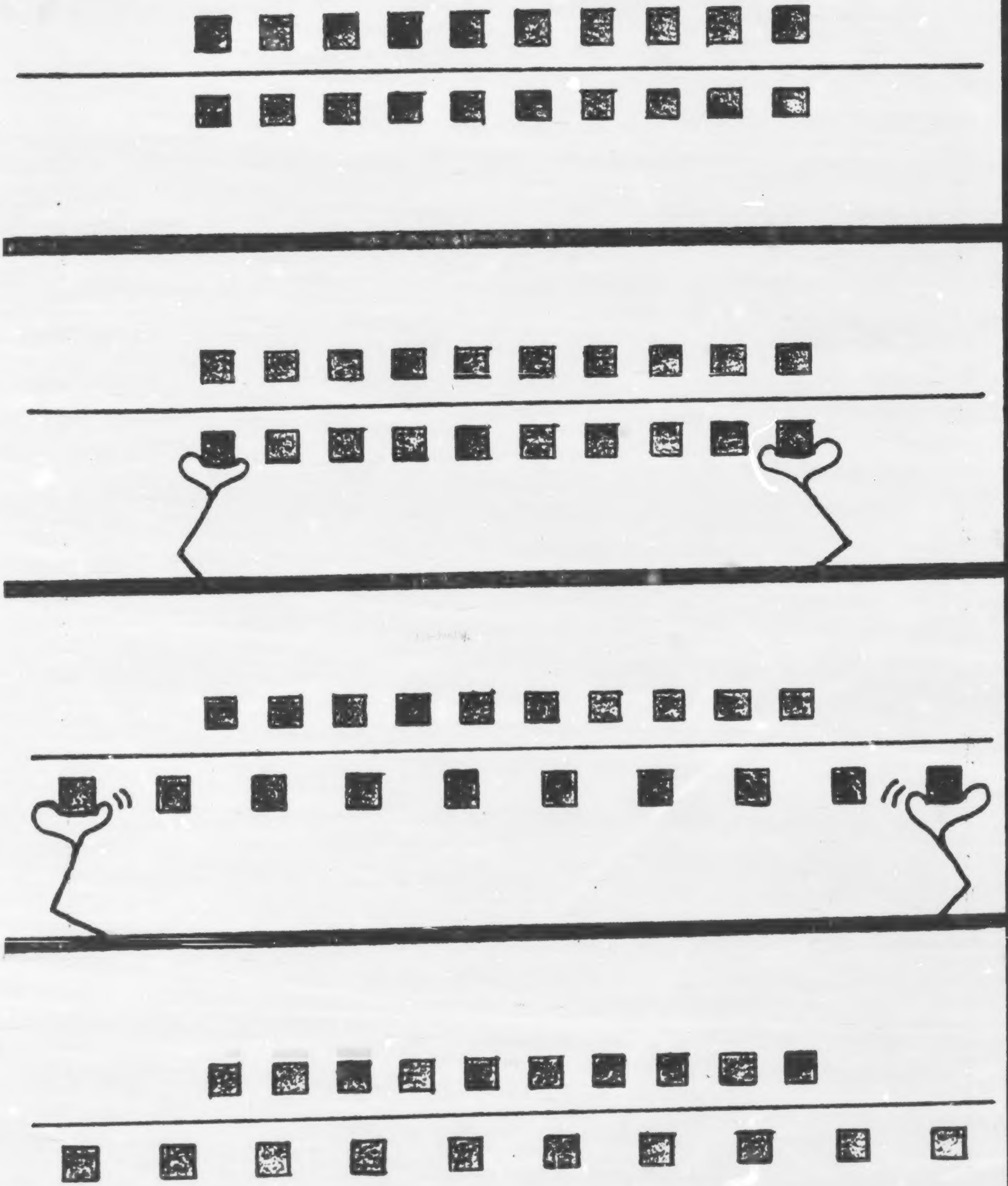


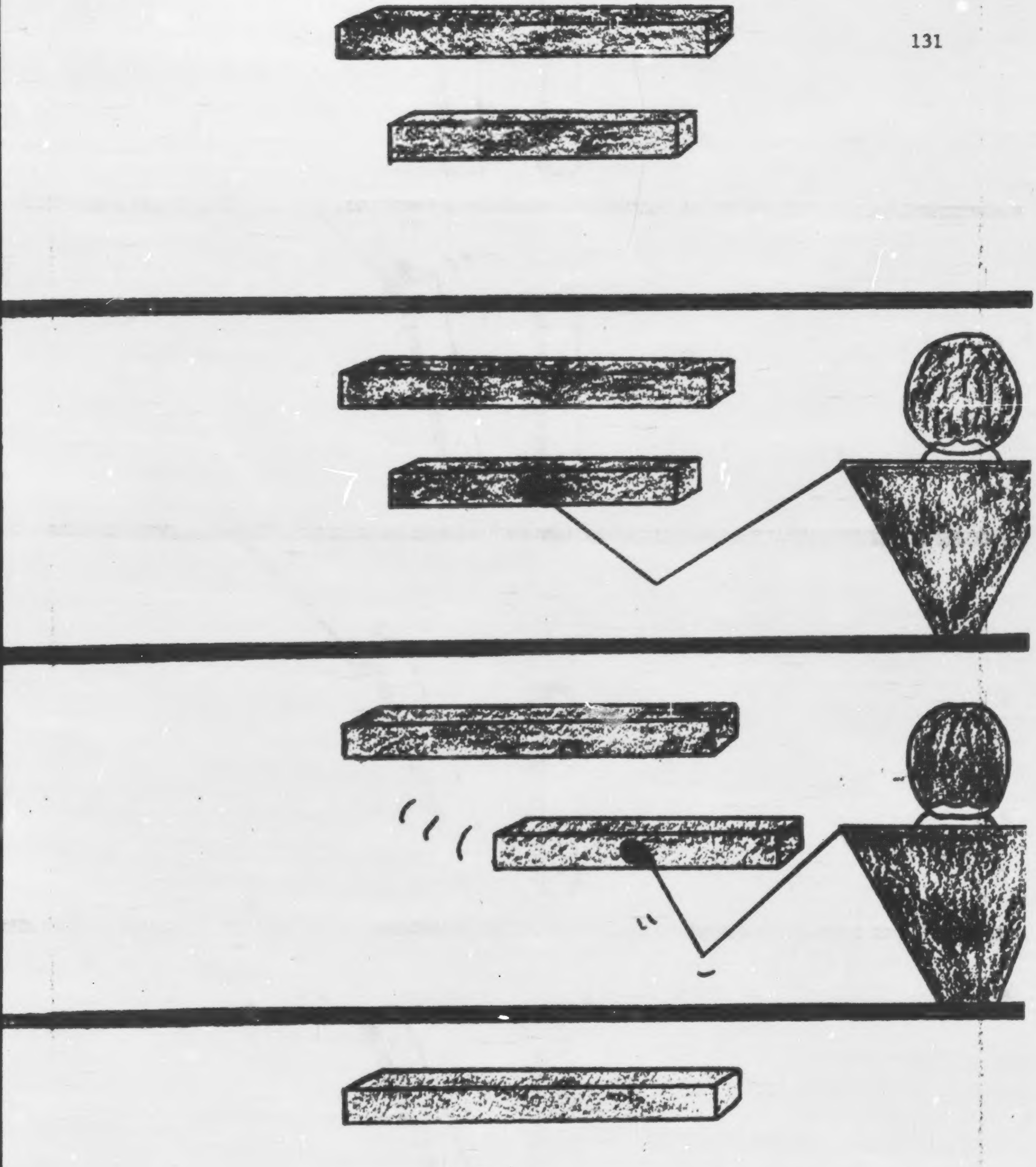


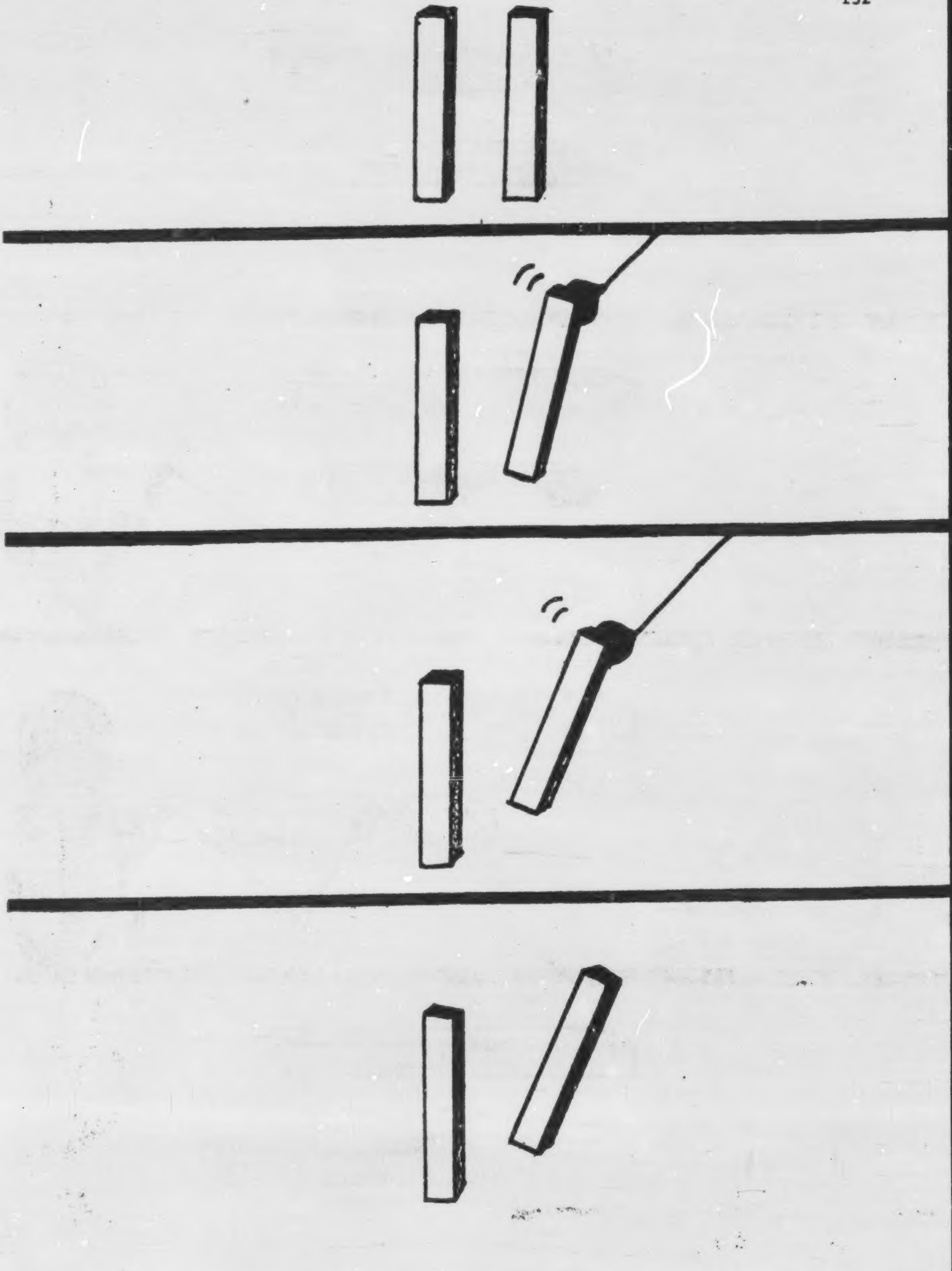


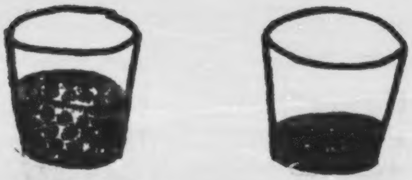


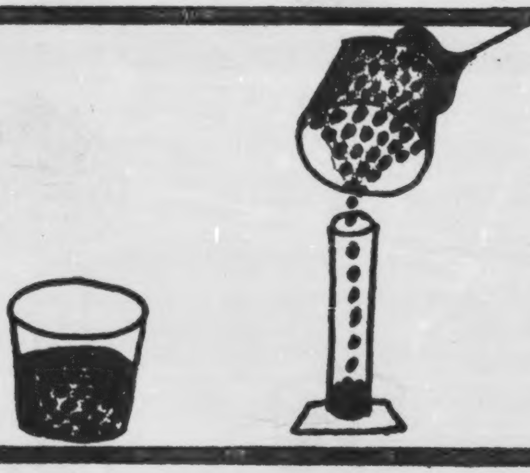


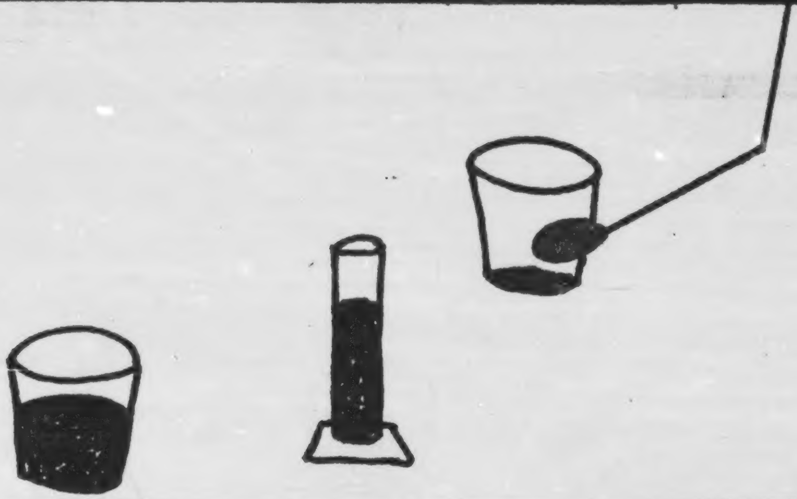


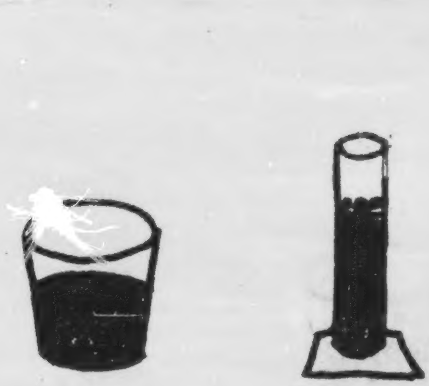


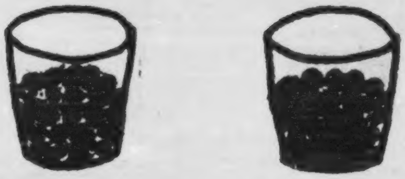


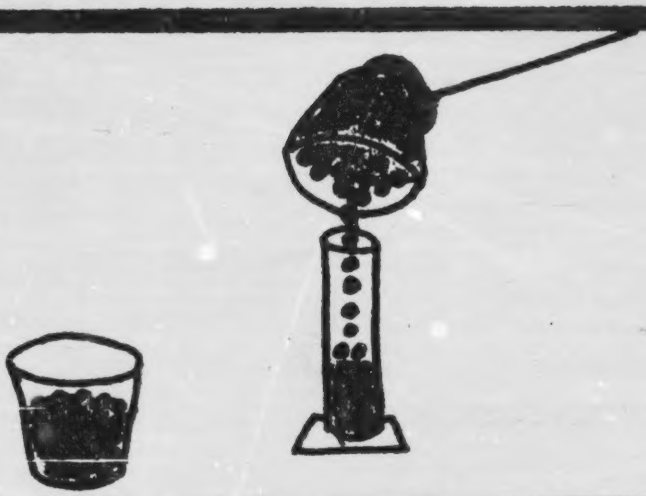


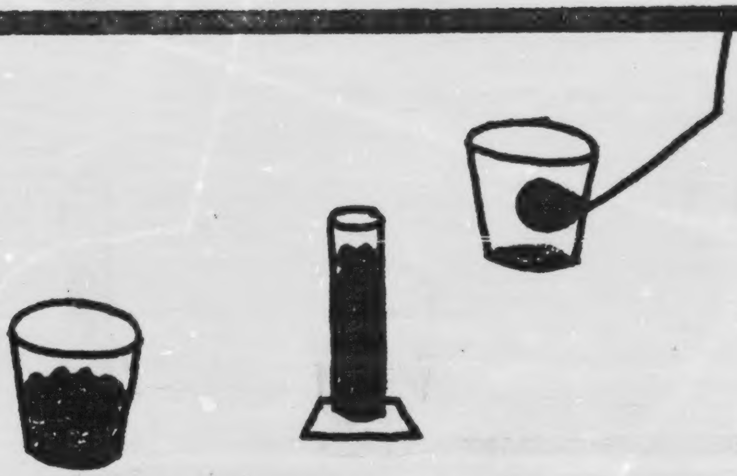


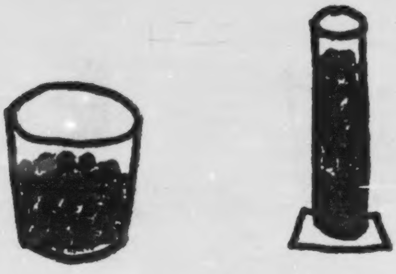


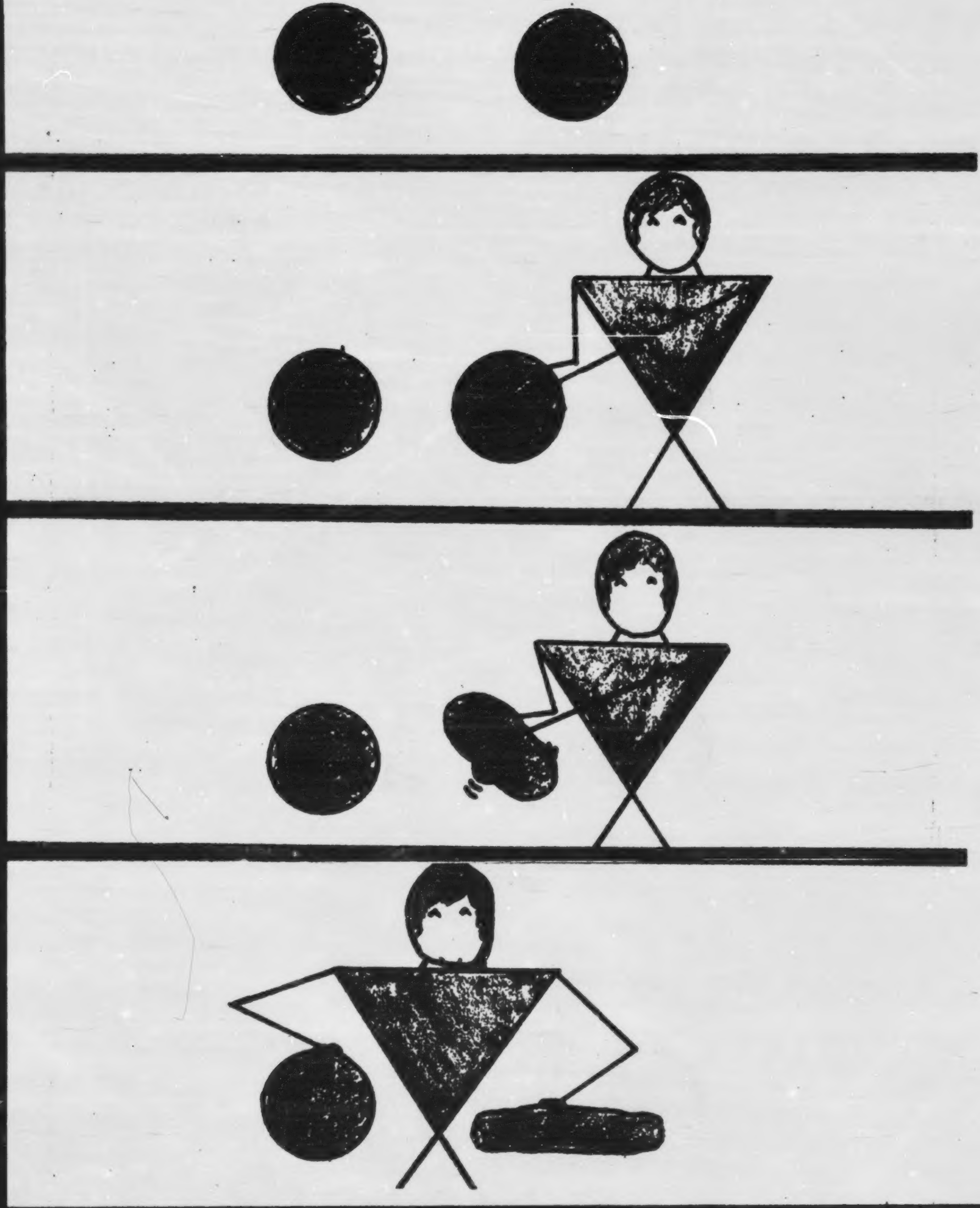


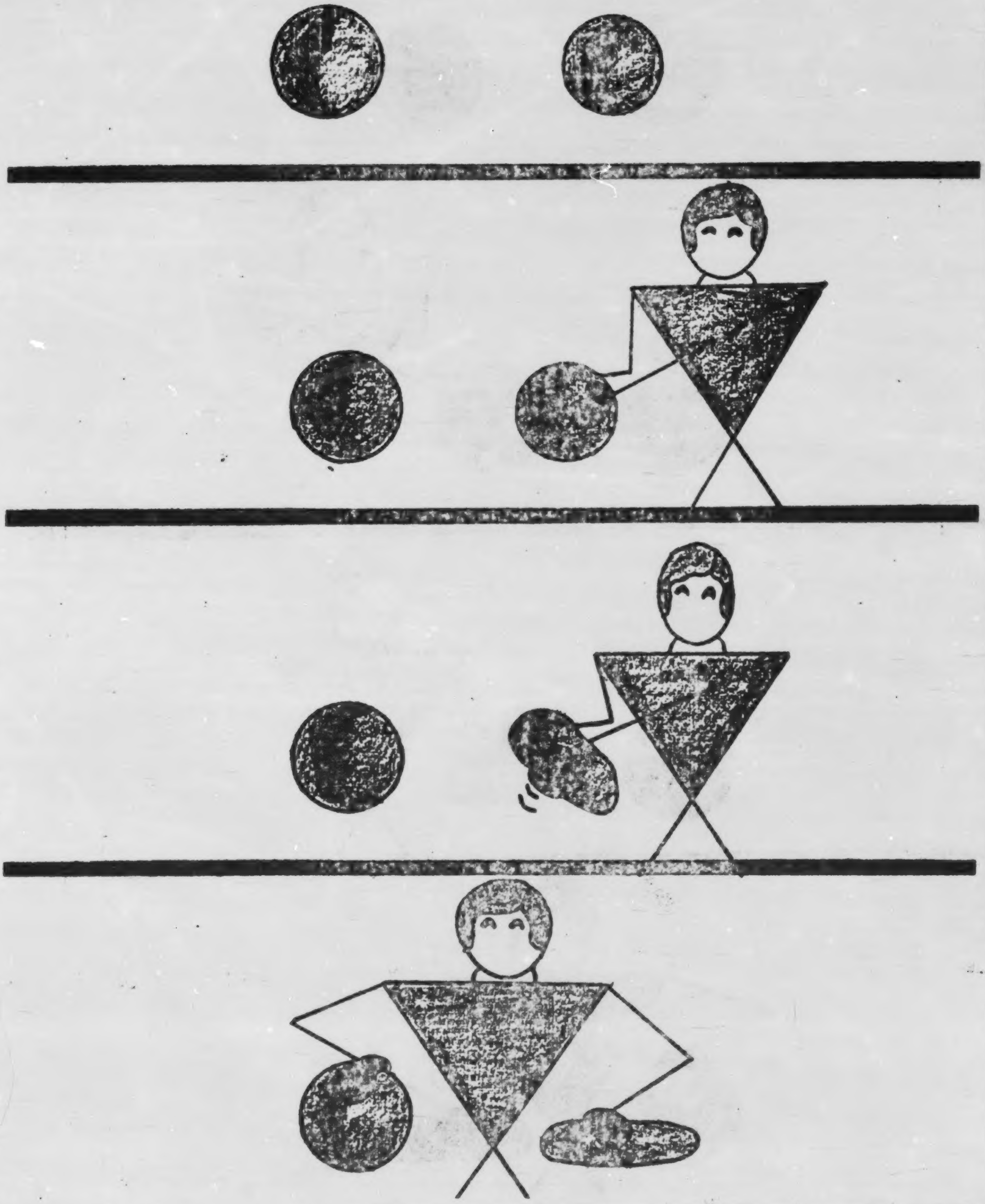


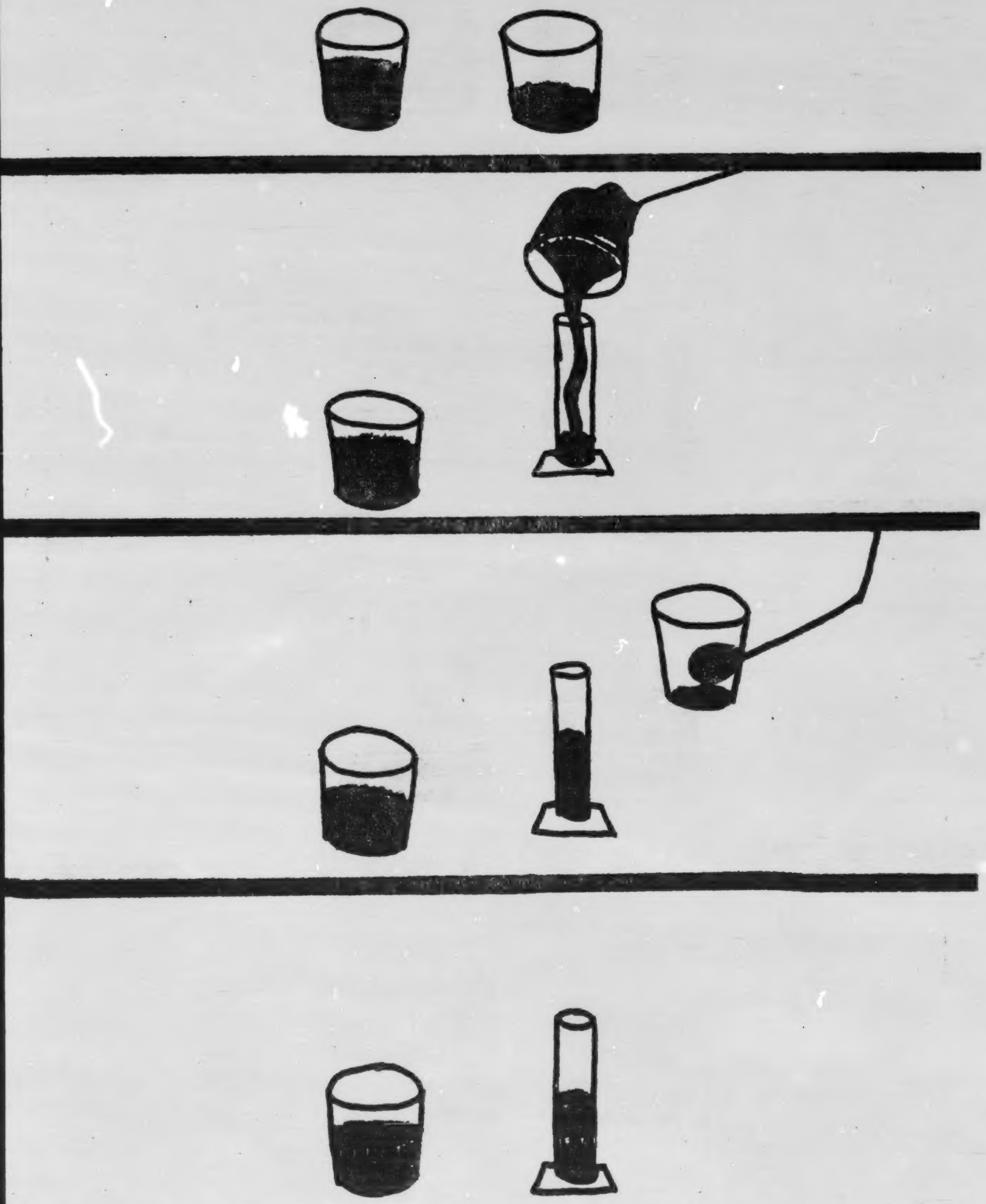


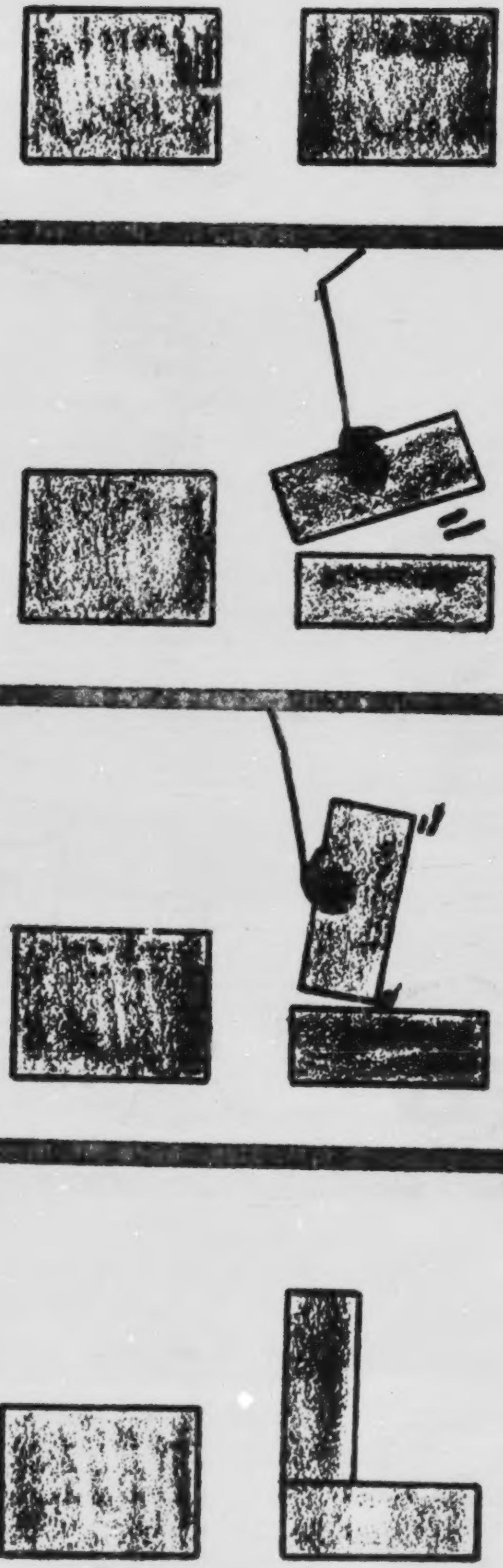


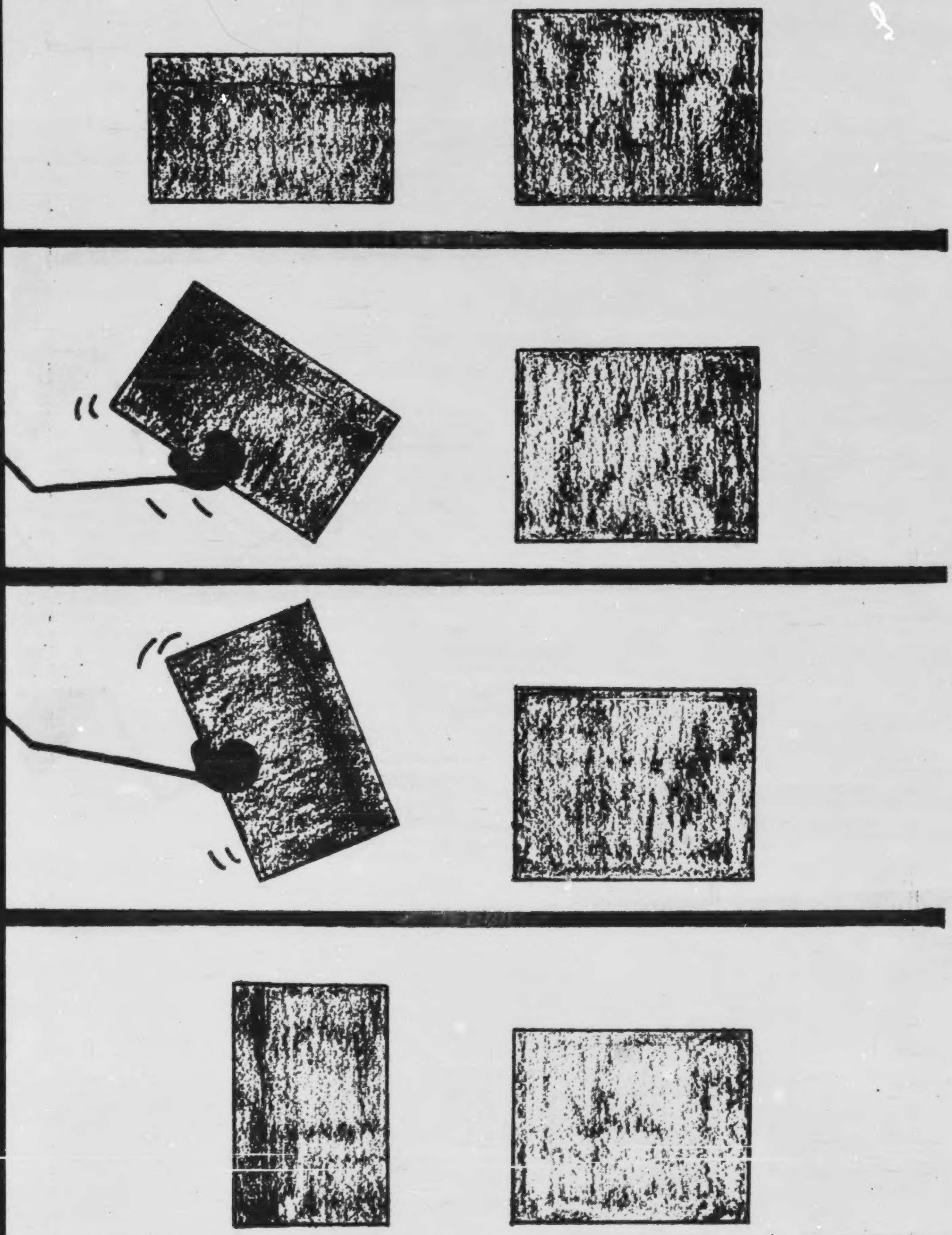


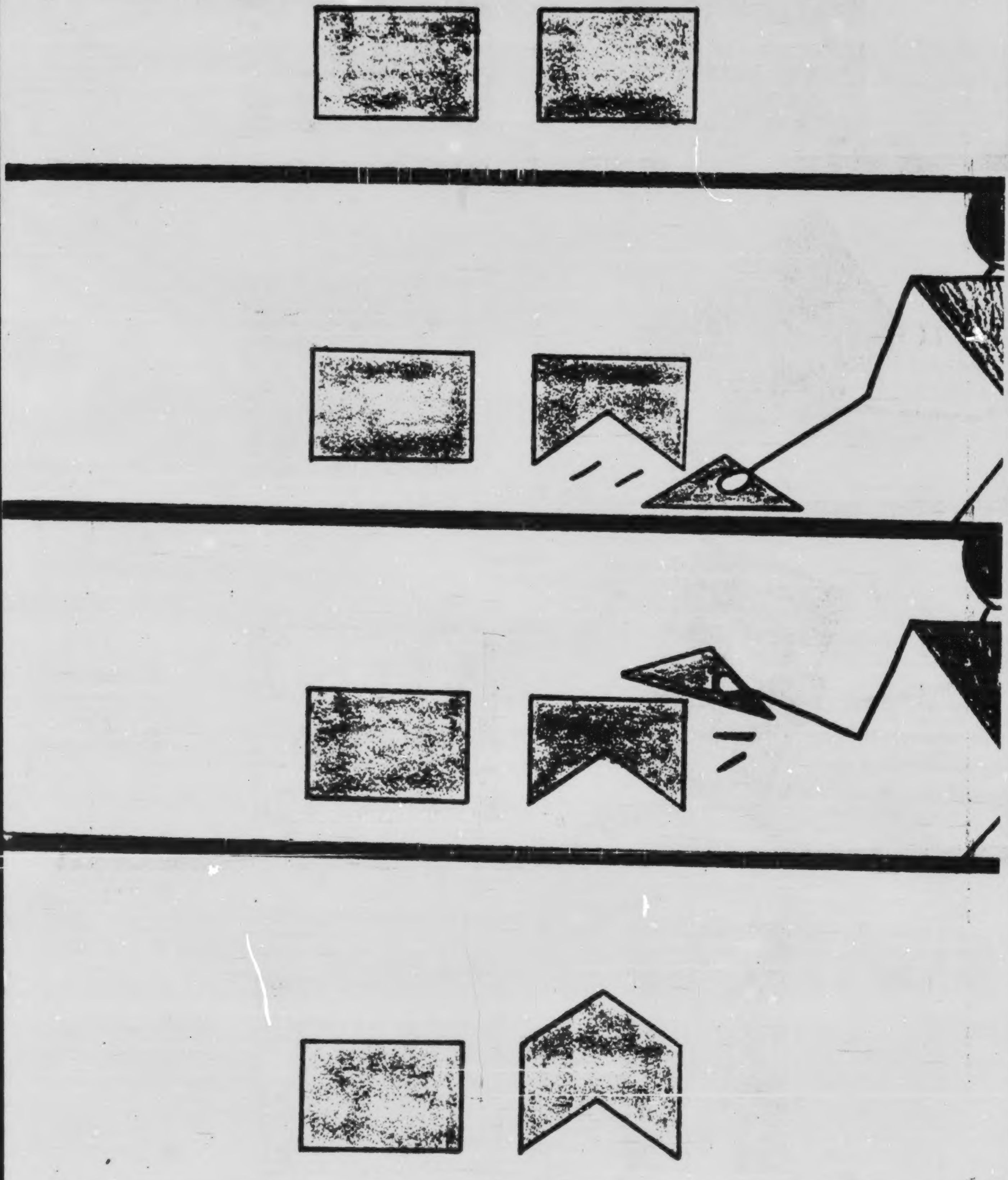


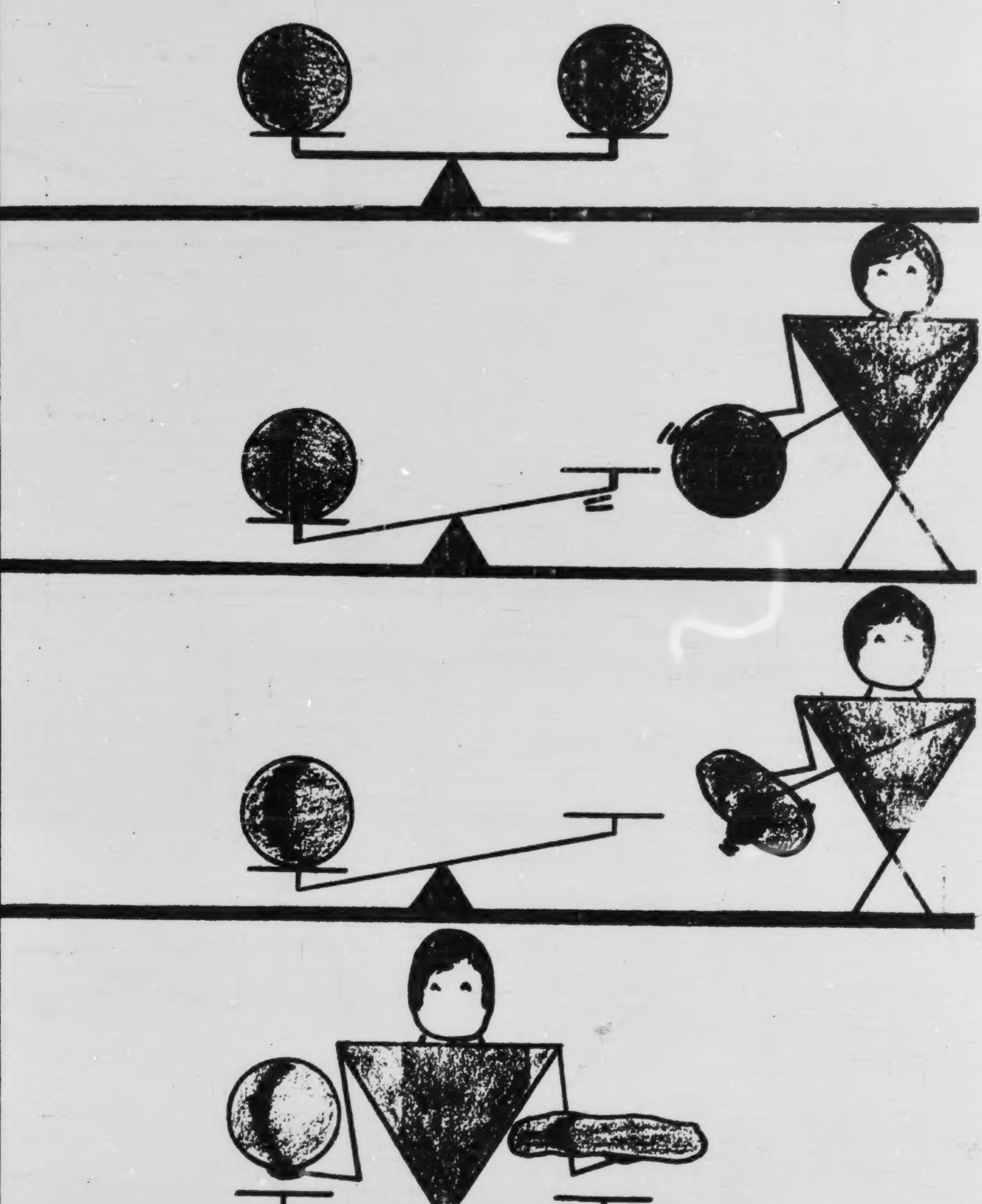


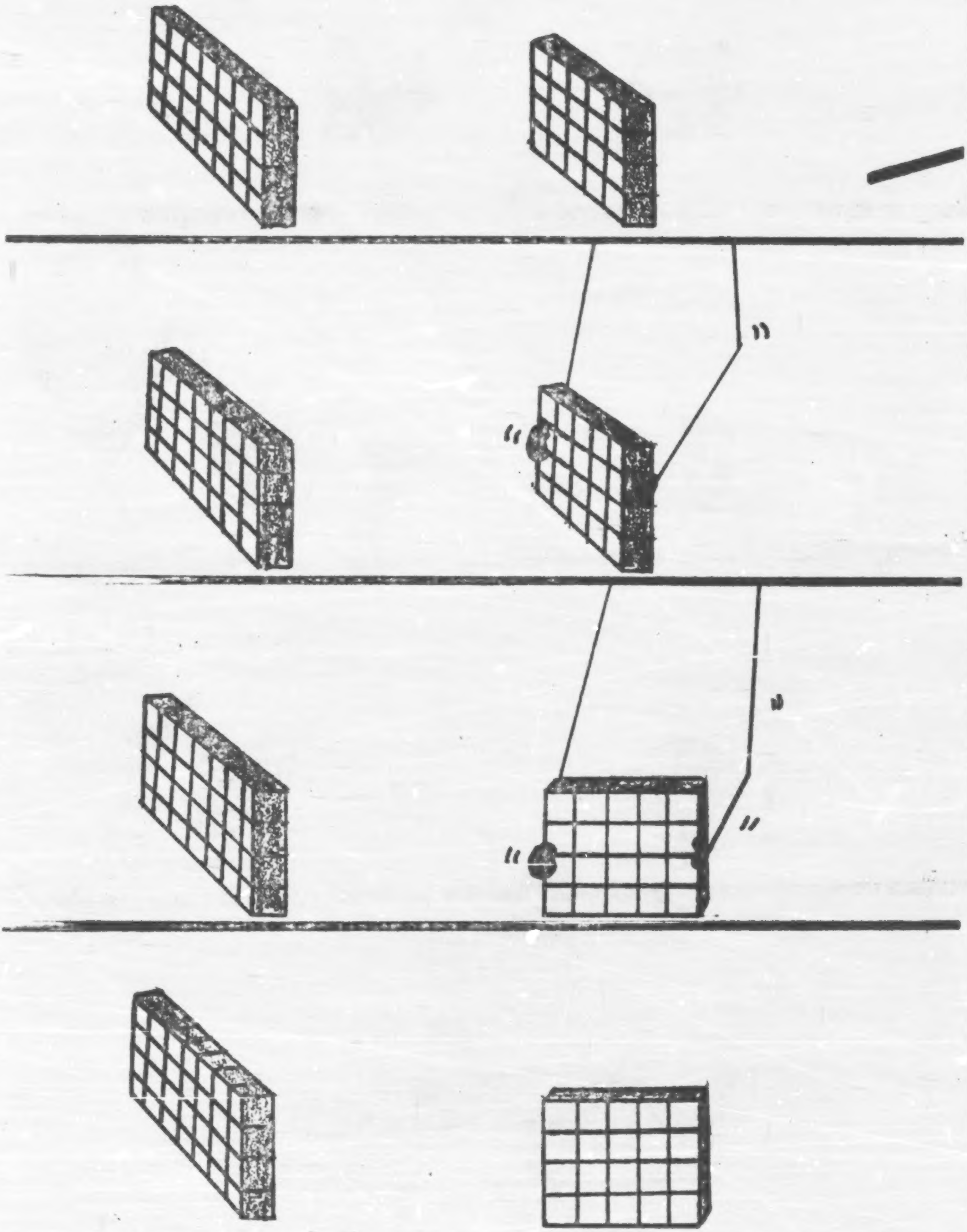


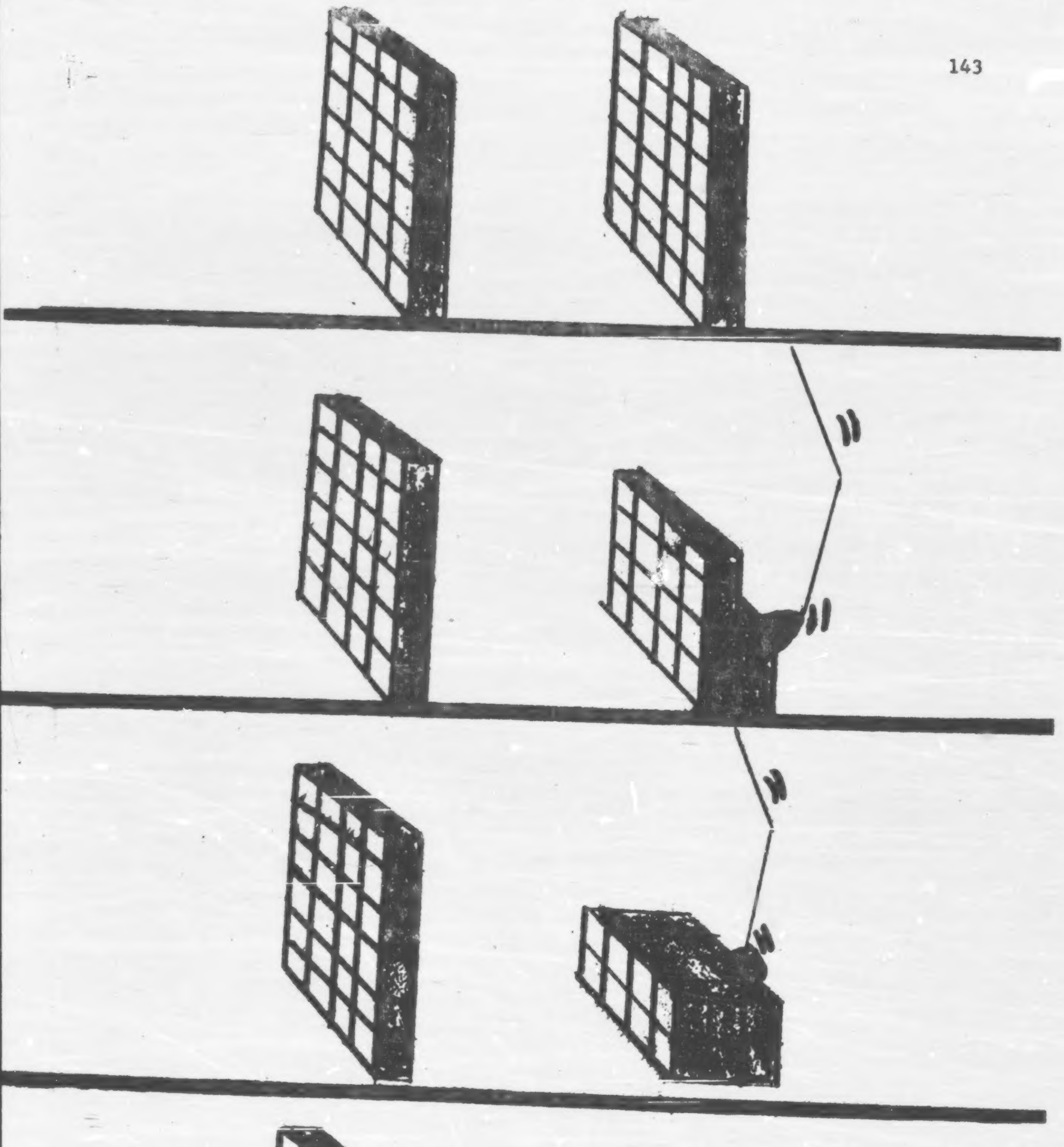












APPENDIX II

PROBLEM-SOLVING TESTS

SCRIPT - MODELS FORM

Hello, boys and girls. We are going to do something today we think you will enjoy. We are going to show you some models like this one (show model). When we show you models like these, we want you to look at them closely, because we are going to ask you some questions about them.

Now we are going to pass out answer books. When you get your book, put your name - your full name - and your grade on the lines on the cover. If you have any questions, raise your hand and we will help you. (Pause 15 sec.) OK, turn to page 1 in your books. We are going to do the first one together, as an example.

I am going to read the paragraph at the top of the page. You read silently as I go along.

Look at the model closely. We do not know what is going on. What do you think would be the best question for us to ask if we wanted to find out what is going on in the model? Look at the three boxes below. Put an X in the box that has the best question to ask.

A. Why is the door so big?

B. Why is it snowing?

C. Why is the small boy trying so hard to open the door?

Go ahead and put an X in the box you think has the best question.

(Pause 7 sec)

I am going to tell you the answer this time. "C" is the answer. Why is the small boy trying so hard to open the door?

Now, turn to page 2. Now you can do the rest on your own. I will not tell you the correct answers each time.

Here is number 1. (show model)

What do you think the problem is?

A. The boy's dog is lost.
B. The boy broke the dog's rope.
C. The boy thinks his dog has run away.

(Pause 7 sec)

Number 2. (show model) What is the problem here?

A. The boy sees something that frightens him.
B. The boy is afraid it will rain.
C. The boy is afraid his tent will fall down.

(Pause 7 sec)

Number 3. (show model) Now I am going to ask you to do something different. I want you to pick the best question to ask to help figure out what is going on in the model.

Put an "X" in the box you think has the best question to ask.

A. Were the 3 boys mean to the small boy?
B. Are the books interesting?
C. Can they get a drink?

(Pause 5 sec)

Number 4. (show model) Here is another model. What is the best question to ask?

A. Why is the house so large?

B. Why is the girl running toward the boys?

C. Is the small boy her brother?

(Pause 5 sec)

Now turn to page 3. Look at this next model. Number 1 again. (show model) Now, I want you to figure out the causes of the problem. These 2 cars just had a smashup. What do you think is the best guess of the cause of the accident?

A. The black car slid on ice.

B. The white car was going too fast.

C. The sun was too bright.

(Pause 5 sec)

Number 2. Which one of these three is the best guess of the cause of the accident?

A. The sun blinded the driver of the black car.

B. The stop sign was too small to see.

C. The black car was driving too fast to stop.

(Pause 5 sec)

Number 3. (show model) Here is a new model. These kids are on a committee. The committee must give a report about the Indian Geronimo. Which of these three questions should they ask to be sure they know what to do?

A. Will we still get recess after the report?

B. Did Geronimo kill General Custer?

C. How long should the report be?

(Pause 5 sec)

Now turn to page 4. (show model)

These kids have to plan a party for Halloween. Their problem is that they need quite a bit of money; they need their teacher's permission; and the party must be held on a day when there are no other big events. They find out that they have the money and October 29 is a good day. Do they have enough information to go ahead planning the party? Mark "Yes" if you think they do; "No" if you think they do not; or you can mark "Don't know" if you don't know if they have enough information.

(Pause 7 sec)

Number 2. (show model) This boy wants to build a model airplane. He knows that he needs a razor blade, glue, blue and yellow paint, and a ruler. He gets a razor blade from his father, a ruler from his desk, and glue from the basement. Does he have everything he needs?

(Pause 7 sec)

Now turn to page 5. Here is the next model. (show model) A boy is going to put some books on the shelves. What should he be sure to notice or think about?

A. How many books are on the shelves?

B. Who put the bookcase where it is?

C. Where will he set the books when he gets to the shelves?

(Pause 5 sec)

Number 2. Here are three things the boy could do. Which would be the best thing for him to do first?

A. Ask the boy who is sitting at the table to help.

B. Put the books in the box.

C. Place the books on top of the bookshelf.

(Pause 5 sec)

Number 3. Here are three more things the boy could do. Which would be best for him to do first?

A. Set the books on the table.

B. Push the table over by the shelf.

C. Kick the box out of the way.

(Pause 5 sec)

Now turn to page 6. (show model) Here is the next model. This boy went down to the basement to play. He decided to make a playtown out of some things he found there. He wanted to pretend that the town was real and that a flying saucer had landed in it. He imagined that the police ran out of the police station to see what had landed. What thing could he use for a jail cell?

A. A room in the dollhouse.

B. An old padlock

C. The bird cage.

(Pause 5 sec)

Number 2. What thing could he use for the sun?

A. The window.
B. The lamp.
C. An old record.

(Pause 5 sec)

Now turn to page 7. (show model) Here is the next model. This ball is caught on the roof. Now look at the three choices in your answer book. What is the most unusual way for these children to get the ball down? By unusual we mean a way most people would not think of.

Is it picture A?
Picture B? or
Picture C?

(Pause 5 sec)

Number 2. (show model) This girl has hung some laundry out to dry, but she has used up all the space on the line and still has some laundry left over. What is the most unusual way she can dry the left-over laundry?

A?
B? or
C?

(Pause 5 sec)

Number 3. (show model) These children's swing has broken. They now have no place to swing. What is the most unusual way they can fix it so they can swing?

A. ?

B? or

C?

(Pause 5 sec)

Now turn to page 8. (show model) This girl is going to hang a picture in her room. But she has the the hook very close to the edge of the frame. What will happen if the girl hangs the picture on the wall?

A?

B? or

C?

(Pause 5 sec)

Number 2. (show model) This girl is going to mix some of the red and white paint together. What will happen?

A. She will get a pink color.

B. She will spill all of it.

C. The paint will dry up.

(Pause 5 sec)

Number 3. (show model) What might happen if you piled some more boxes on the second shelf?

A. The cabinet might fall over.

B. The shelf might break under the load.

C. The boxes might not fit.

(Pause 5 sec)

Now turn to page 9. (show model) Here is the next model. This girl's room is very crowded. If you wanted more room to store things, where would you put them?

A. Out in the hallway.

B. In boxes under the bed.

C. In somebody else's room.

(Pause 5 sec)

Number 2. (show model) These boys have to move the dresser upstairs. How would you do it?

A. Empty out the drawers.

B. Carry it up just like it is.

C. Carry the drawers up first.

(Pause 5 sec)

Now turn to page 10. (show model) This girl's school desk is wobbling. (Wiggle string) What could she do to make it steadier?

A. Get a higher chair.

B. Place a piece of folded paper under one leg.

C. Press down harder with her pencil.

(Pause 5 sec)

Number 2. (show model) In this picture a window pane is broken. What could the boy do to stop the cold air from coming in the broken window?

A. Put a piece of cardboard over the window pane.

B. Put a chair in front of the window.

C. Build a fire in the fireplace.

(Pause 5 sec)

Number 3. (show model) This girl is finishing a test in school. Before handing it to the teacher, what should she do?

A. Check her work.

B. Write a letter to a friend.

C. Copy her answers on another piece of paper.

Now close your books and make sure your name is on the first page. We will come to your desk and collect your books.

NAME ____________________

GRADE ____________________

BOY ________ GIRL ________

(Models)

EXAMPLE

LOOK AT THE MODEL CLOSELY. WE DO NOT KNOW WHAT IS GOING ON. WHAT DO YOU THINK WOULD BE THE BEST QUESTION FOR US TO ASK IF WE WANTED TO FIND OUT WHAT IS GOING ON IN THE MODEL? LOOK AT THE THREE BOXES BELOW. PUT AN "X" IN THE BOX THAT HAS THE BEST QUESTION TO ASK.

A

WHY IS THE DOOR SO BIG?

B

WHY IS IT SNOWING?

C

WHY IS THE SMALL BOY TRYING SO HARD TO OPEN THE DOOR?

	A	B	C
1	THE BOY'S DOG IS LOST.	THE BOY BROKE THE DOG'S ROPE.	THE BOY THINKS HIS DOG HAS RUN AWAY.
2	THE BOY SEES SOMETHING THAT FRIGHTENS HIM.	THE BOY IS AFRAID IT WILL RAIN.	THE BOY IS AFRAID HIS TENT WILL FALL DOWN.
3	WERE THE 3 BOYS MEAN TO THE SMALL BOY?	ARE THE BOOKS INTERESTING?	CAN THEY GET A DRINK?
4	WHY IS THE HOUSE SO LARGE?	WHY IS THE GIRL RUNNING TOWARD THE BOYS?	IS THE SMALL BOY HER BROTHER?

2

	A	B	C
1	THE BLACK CAR SLID ON ICE.	THE WHITE CAR WAS GOING TOO FAST.	THE SUN WAS TOO BRIGHT.
2	THE SUN BLINDED THE DRIVER OF THE BLACK CAR.	THE STOP SIGN WAS TOO SMALL TO SEE.	THE BLACK CAR WAS DRIVING TOO FAST TO STOP.
3	WILL WE STILL GET RECESS AFTER THE REPORT?	DID GERONIMO KILL GENERAL CUSTER?	HOW LONG SHOULD THE REPORT BE?

3

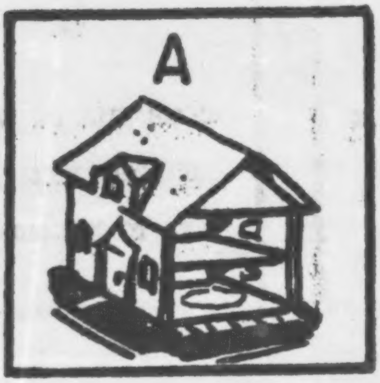
1	YES	NO	DON'T KNOW
2	YES	NO	DON'T KNOW

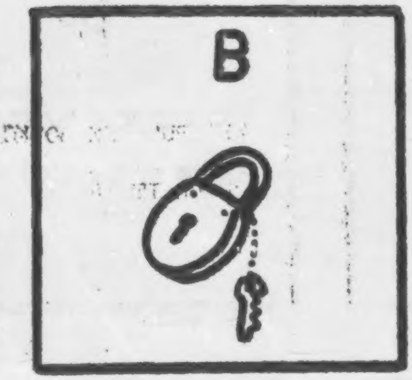
4

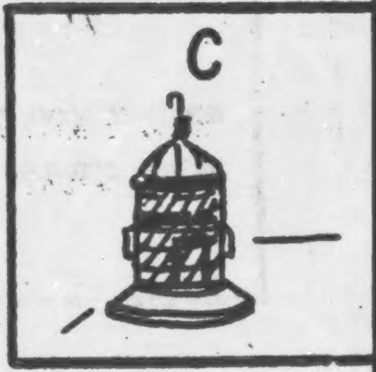
	A	B	C
1	HOW MANY BOOKS ARE ON THE SHELVES?	WHO PUT THE BOOKCASE WHERE IT IS?	WHERE WILL HE SET THE BOOKS WHEN HE GETS TO THE SHELF?
2	ASK THE BOY WHO IS SITTING AT THE TABLE TO HELP.	PUT THE BOOKS IN THE BOX.	PLACE THE BOOKS ON TOP OF THE BOOKSHELF.
3	SET THE BOOKS ON THE TABLE.	PUSH THE TABLE OVER BY THE SHELF.	KICK THE BOX OUT OF THE WAY.

5

1







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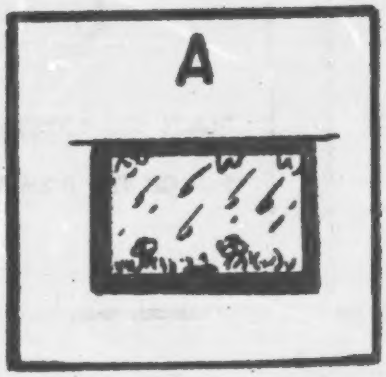

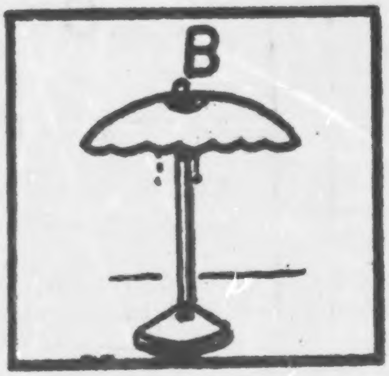

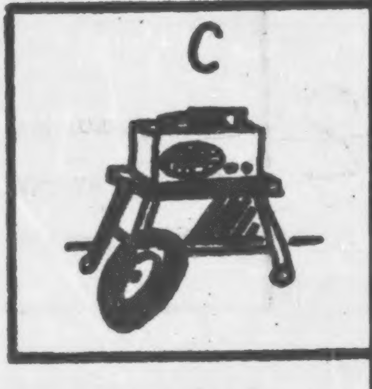

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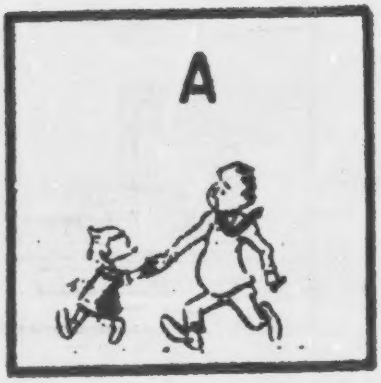
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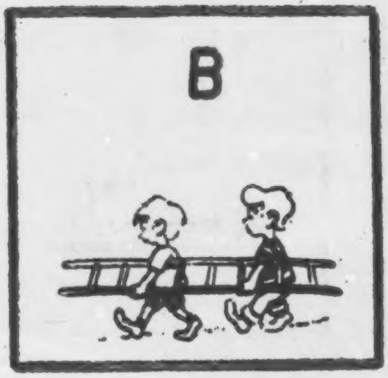
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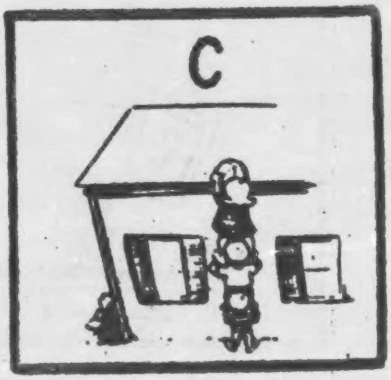
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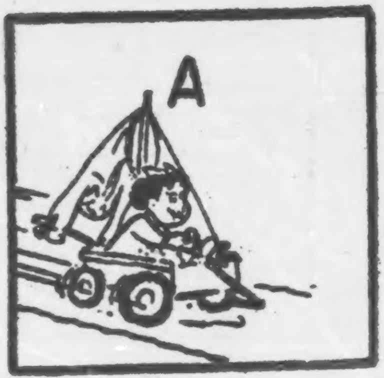
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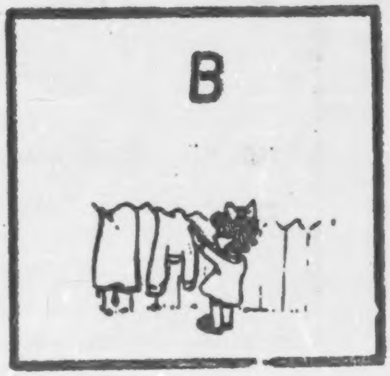
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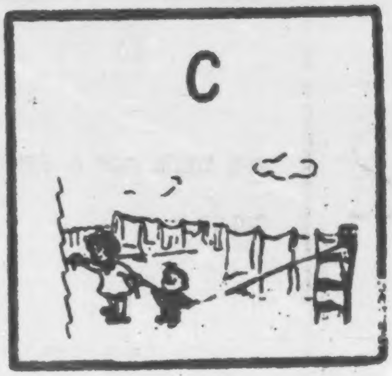
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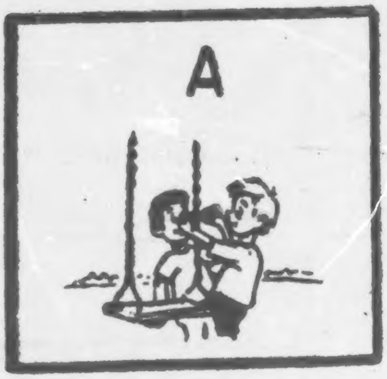
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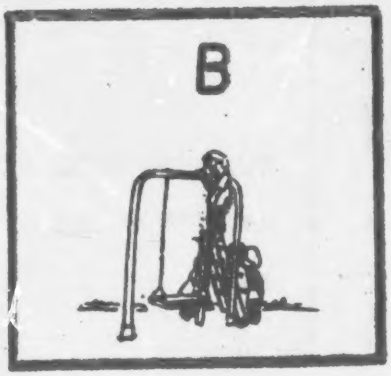
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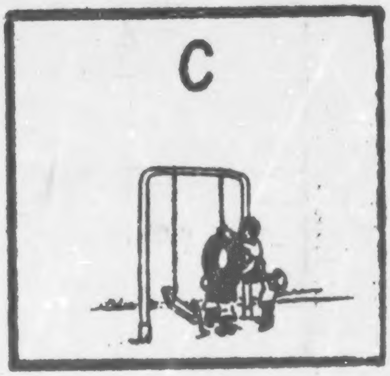
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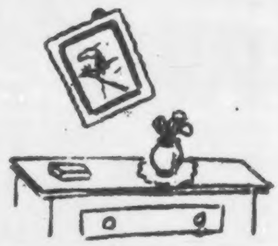
1

A



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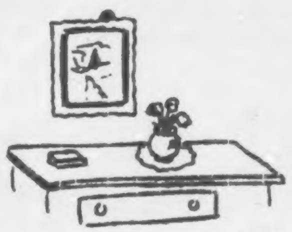

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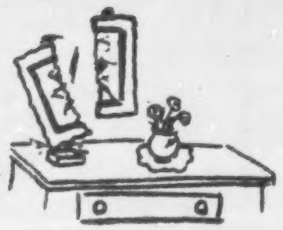

2

A

SHE WILL GET A PINK COLOR.

B

SHE WILL SPILL ALL OF IT.

C

THE PAINT WILL DRY UP.

3

A

THE CABINET MIGHT FALL OVER.

B

THE SHELF MIGHT BREAK UNDER THE LOAD.

C

THE BOXES MIGHT NOT FIT.

A

OUT IN THE HALLWAY.

B

IN BOXES UNDER THE BED.

C

IN SOMEBODY ELSE'S ROOM.

2

A

EMPTY OUT THE DRAWERS.

B

CARRY IT UP JUST LIKE IT IS.

C

CARRY THE DRAWERS UP FIRST.

9

	A	B	C
1	GET A HIGHER CHAIR.	PLACE A PIECE OF FOLDED PAPER UNDER ONE LEG.	PRESS DOWN HARDER WITH HER PENCIL.
2	PUT A PIECE OF CARDBOARD OVER THE WINDOW PANE.	PUT THE CHAIR IN FRONT OF THE WINDOW.	BUILD A FIRE IN THE FIREPLACE.
3	CHECK HER WORK.	WRITE A LETTER TO A FRIEND.	COPY HER ANSWERS ON ANOTHER PIECE OF PAPER.

SCRIPT - SLIDES FORM

Hello boys and girls. We are going to do something today we think you will enjoy. We are going to show you some pictures like this one (show slide). When we show you pictures like these, we want you to watch them closely, because we are going to ask you some questions about the pictures.

Now we are going to pass out answer books. When you get your book, put your name - your full name - and your grade on the lines on the cover. If you have any questions, raise your hand and we will help you. (Pause 15 sec.) OK, turn to page 1 in your books. We are going to do the first one together, as an example.

I am going to read the paragraph at the top of the page. You read silently as I go along.

Look closely at the picture. Two girls are arguing over who is going to play with the doll. What might happen if they keep pulling on the doll? Look at the three boxes below. Put an "X" in the box that tells what might happen if the girls keep pulling on the doll.

A. They will take turns playing with it.

B. One of the girls will win.

C. The doll may rip.

Put an X in the box you think tells what will happen.
(Pause 7 sec)

I'm going to tell you the answer this time. "C" is the answer. The doll may rip.

Now, turn to page 2. Now you can do the rest on your own. I will not tell you the correct answers each time.

Here is number 1. (show slide)

What do you think the problem is.

A. The boy's dog is lost.

B. The boy broke the dog's rope.

C. The boy thinks his dog has run away.

(Pause 7 sec)

Number 2. (show slide) What is the problem here?

A. The boy sees something that frightens him.

B. The boy is afraid it will rain.

C. The boy is afraid his tent will fall down.

(Pause 7 sec)

Number 3. (show slide) Now I am going to ask you to do something different. I want you to pick the best question to ask to help figure out what is going on in the picture.

Put an X in the box you think has the best question to ask.

A. Were the 3 boys mean to the small boy?

B. Are the books interesting?

C. Can they get a drink?

(Pause 5 sec)

Number 4. (show slide) Here is another picture. What is the best question to ask?

A. Why is the house so large?

B. Why is the girl running toward the boys?

C. Is the small boy her brother?

(Pause 5 sec)

Now turn to page 3. Look at this next picture. Number 1 again. (show slide) Now, I want you to figure out the causes of the problem. These 2 cars just had a smashup. What do you think is the best guess of the cause of the accident?

A. The black car slid on ice.

B. The white car was going too fast.

C. The sun was too bright.

(Pause 5 sec)

Number 2. Which one of these three is the best guess of the cause of the accident?

A. The sun blinded the driver of the black car.

B. The stop sign was too small to see.

C. The black car was driving too fast to stop.

(Pause 5 sec)

Number 3 (show slide) Here is a new picture. These kids are on a committee. The committee must give a report about the Indian Geronimo. Which of these three questions should they ask to be sure they know what to do?

A. Will we still get recess after the report?

B. Did Geronimo kill General Custer?

C. How long should the report be?

(Pause 5 sec)

Now turn to page 4. (show slide)

These kids have to plan a party for Halloween. Their problem is that they need quite a bit of money; they need their teacher's permission; and the party must be held on a day when there are no other big events. They find out that they have the money and October 29th is a good day. Do they have enough information to go ahead planning the party? Mark "Yes" if you think they do; "No" if you think they do not; or you can mark "Don't know" if you don't know if they have enough information.

(Pause 7 sec)

Number 2. (show slide) This boy wants to build a model airplane. He knows that he needs a razor blade, glue, blue and yellow paint, and a ruler. He gets a razor blade from his father, a ruler from his desk, and glue from the basement. Does he have everything he needs?

(Pause 7 sec) Now turn to page 5.

Here is the next picture. (show slide)

A boy is going to put some books on the shelves. What should he be sure to notice or think about?

A. How many books are on the shelves?

B. Who put the bookcase where it is?

C. Where will he set the books when he gets to the shelves?

(Pause 5 sec)

Number 2. Here are three things the boy could do. Which would be the best thing for him to do first?

A. Ask the boy who is sitting at the table to help.

B. Put the books in the box.

C. Place the books on top of the bookshelf.

(Pause 5 sec)

Number 3. Here are three more things the boy could do. Which would be the best for him to do first?

A. Set the books on the table.

B. Push the table over by the shelf.

C. Kick the box out of the way.

(Pause 5 sec) Now turn to page 6. (show slide)

Here is the next picture. This boy went down to the basement to play. He decided to make a playtown out of some things he found there. He wanted to pretend that the town was real and that a flying saucer had landed in it. He imagined that the police ran out of the police station to see what had landed. What thing could he use for a jail cell?

A. A room in the dollhouse.

B. An old padlock.

C. The bird cage.

(Pause 5 sec)

Number 2. What could he use for the sun?

A. The window.

B. The lamp.

C. An old record.

(Pause 5 sec) Now turn to page 7. (show slide)

Here is the next picture. This ball is caught on the roof. Now look at the three choices in your answer book. What is the unusual way for these children to get the ball down? By unusual we mean a way most people would not think of.

Is it picture A? (show slide)
Picture B? or (show slide)
Picture C?

(Pause 5 sec)

Number 2. (show slide) This girl has hung some laundry out to dry, but she has used up all the space on the line and still has some laundry left over. What is the most unusual way she can dry the left-over laundry?

A? (show slide)
B? or (show slide)
C? (show slide)

(Pause 5 sec)

Number 3 (show slide) These children's swing has broken. They now have no place to swing. What is the most unusual way they can fix it so they can swing?

A? (show slide)
B? or (show slide)
C? (show slide)

(Pause 5 sec) Now turn to page 8. (show slide)

This girl is going to hang a picture in her room. But she has the hook very close to the edge of the frame. What will happen if the girl hangs the picture on the wall?

A? (show slide)

B? or (show slide)

C? (show slide)

(Pause 5 sec)

Number 2. (show slide) This girl is going to mix some of the red and white paint together. What will happen?

A. She will get a pink color.

B. She will spill all of it.

C. The paint will dry up.

(Pause 5 sec)

Number 3. (show slide) What might happen if you piled some more boxes on the second shelf?

A. The cabinet might fall over.

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C. The boxes might not fit.

(Pause 5 sec) Now turn to page 9. (show slide)

Here is the next picture. This girl's room is very crowded. If you wanted more room to store things, where would you put them?

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C. In somebody else's room.

(Pause 5 sec)

Number 2. (show slide). These boys have to move the dresser upstairs. How would you do it?

A. Empty out the drawers.

B. Carry it up just like it is.

C. Carry the drawers up first.

(Pause 5 sec) Now turn to page 10. (show slide)

This girl's school desk is wobbling. What could she do to make it steadier?

A. Get a higher chair.

B. Place a piece of folded paper under one leg.

C. Press down harder with her pencil.

(Pause 5 sec)

Number 2. (show slide) In this picture a window pane is broken. What could the boy do to stop the cold air from coming in the broken window?

A. Put a piece of cardboard over the window pane.

B. Put a chair in front of the window.

C. Build a fire in the fireplace.

(Pause 5 sec)

Number 3. (show slide) This girl is finishing a test in school. Before handing it to the teacher, what should she do?

A. Check her work.

B. Write a letter to a friend.

C. Copy her answers on another piece of paper.

Now, close your books and make sure your name is on the first page. We will come to your desk and collect your books.

NAME ______________________

GRADE ____________________

BOY _______ GIRL ________

EXAMPLE

LOOK CLOSELY AT THE PICTURE ON THE SCREEN. TWO GIRLS ARE ARGUING OVER WHO IS GOING TO PLAY WITH THE DOLL. WHAT MIGHT HAPPEN IF THEY KEEP PULLING ON THE DOLL? LOOK AT THE THREE BOXES BELOW. PUT AN "X" IN THE BOX THAT TELLS WHAT MIGHT HAPPEN IF THE GIRLS KEEP PULLING ON THE DOLL.

A

THEY WILL TAKE TURNS PLAYING WITH IT.

B

ONE OF THE GIRLS WILL WIN.

C

THE DOLL MAY RIP.

1	**A** THE BOY'S DOG IS LOST.	**B** THE BOY BROKE THE DOG'S ROPE.	**C** THE BOY THINKS HIS DOG HAS RUN AWAY.
2	**A** THE BOY SEES SOMETHING THAT FRIGHTENS HIM.	**B** THE BOY IS AFRAID IT WILL RAIN.	**C** THE BOY IS AFRAID HIS TENT WILL FALL DOWN.
3	**A** WERE THE 3 BOYS MEAN TO THE SMALL BOY?	**B** ARE THE BOOKS INTERESTING?	**C** CAN THEY GET A DRINK?
4	**A** WHY IS THE HOUSE SO LARGE?	**B** WHY IS THE GIRL RUNNING TOWARD THE BOYS?	**C** IS THE SMALL BOY HER BROTHER?

2

	A	B	C
1	THE BLACK CAR SLID ON ICE.	THE WHITE CAR WAS GOING TOO FAST.	THE SUN WAS TOO BRIGHT.
2	THE SUN BLINDED THE DRIVER OF THE BLACK CAR.	THE STOP SIGN WAS TOO SMALL TO SEE.	THE BLACK CAR WAS DRIVING TOO FAST TO STOP.
3	WILL WE STILL GET RECESS AFTER THE REPORT?	DID GERONIMO KILL GENERAL CUSTER?	HOW LONG SHOULD THE REPORT BE?

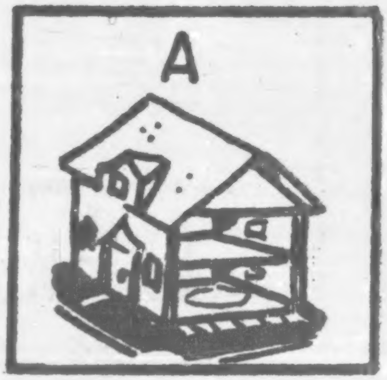
1	YES	NO	DON'T KNOW
2	YES	NO	DON'T KNOW

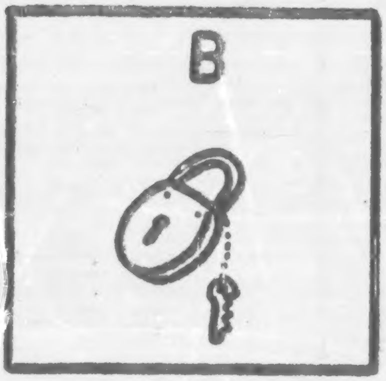
4

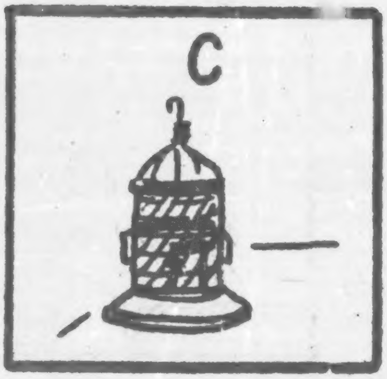
	A	B	C
1	HOW MANY BOOKS ARE ON THE SHELVES?	WHO PUT THE BOOKCASE WHERE IT IS?	WHERE WILL HE SET THE BOOKS WHEN HE GETS TO THE SHELF?
2	ASK THE BOY WHO IS SITTING AT THE TABLE TO HELP.	PUT THE BOOKS IN THE BOX.	PLACE THE BOOKS ON TOP OF THE BOOKSHELF.
3	SET THE BOOKS ON THE TABLE.	PUSH THE TABLE OVER BY THE SHELF.	KICK THE BOX OUT OF THE WAY.

5

1







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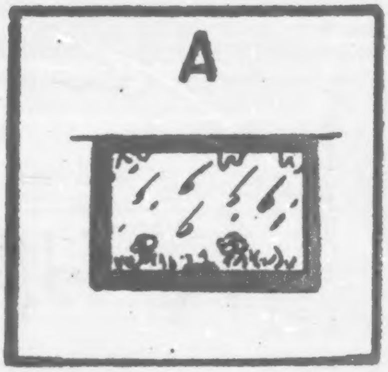

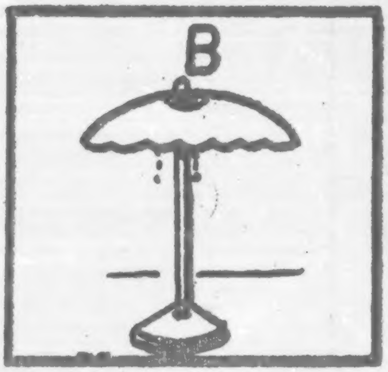

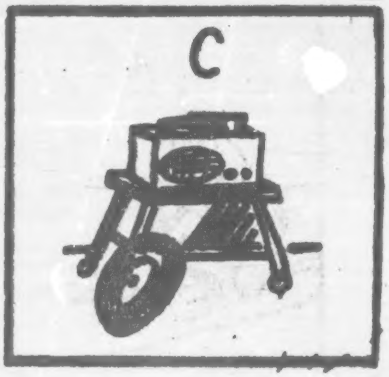

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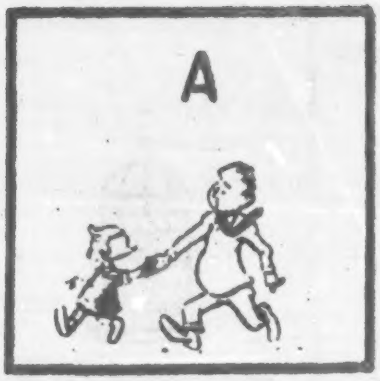

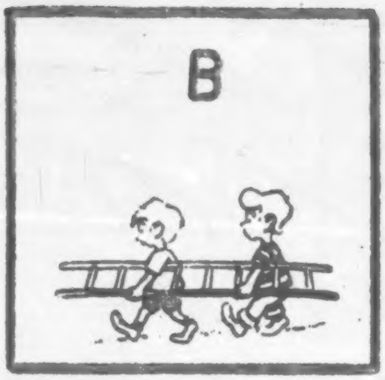

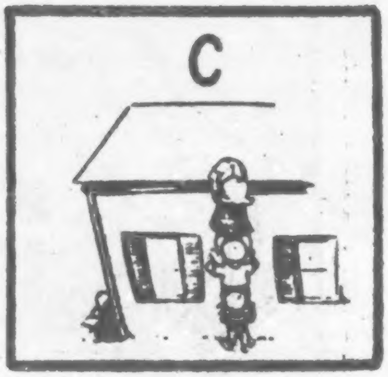

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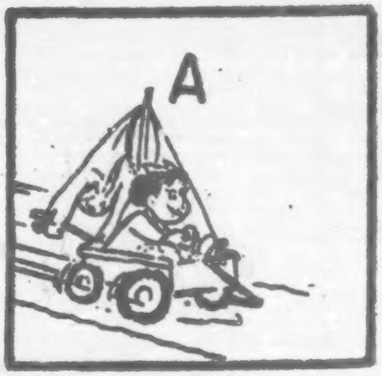

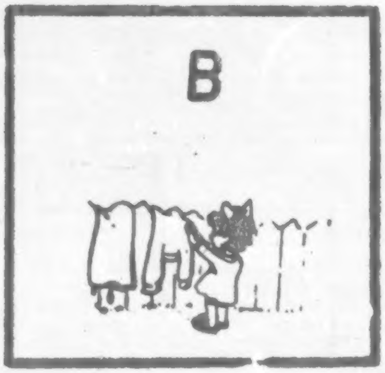

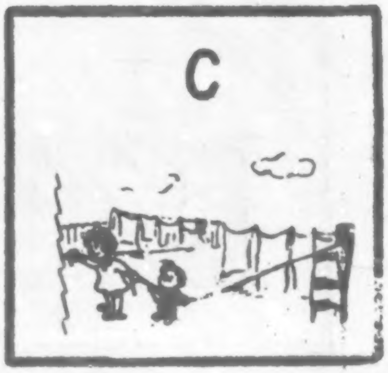

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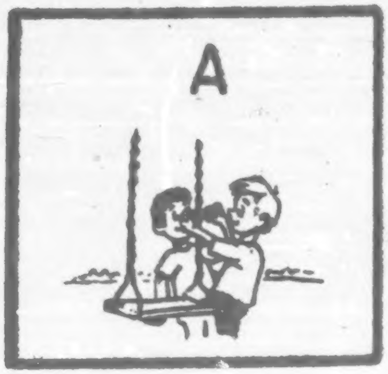
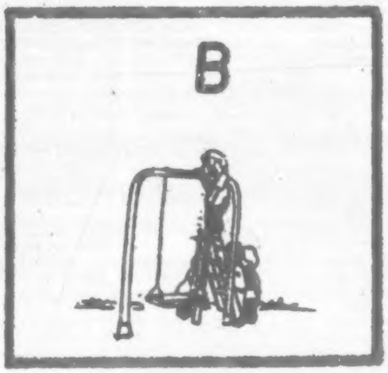
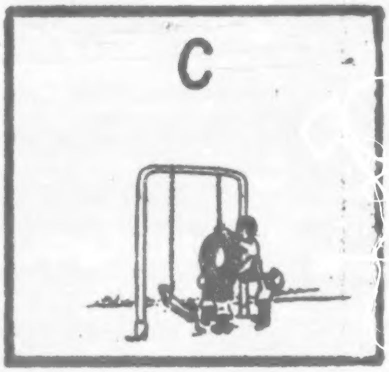
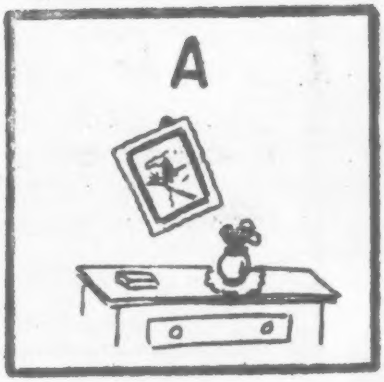






A



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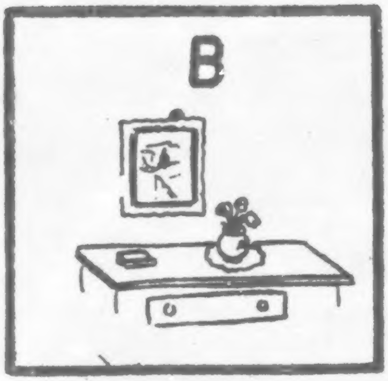

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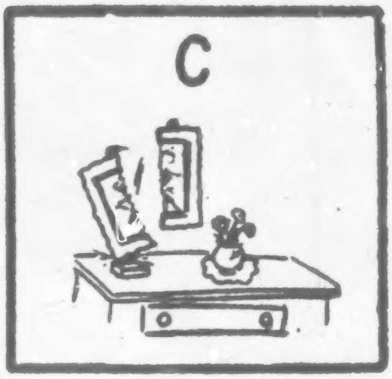


2

A

SHE WILL GET A PINK COLOR.

B

SHE WILL SPILL ALL OF IT.

C

THE PAINT WILL DRY UP.

3

A

THE CABINET MIGHT FALL OVER.

B

THE SHELF MIGHT BREAK UNDER THE LOAD.

C

THE BOXES MIGHT NOT FIT.

8

	A	B	C
1	OUT IN THE HALLWAY.	IN BOXES UNDER THE BED	IN SOMEBODY ELSE'S ROOM.
2	EMPTY OUT THE DRAWERS.	CARRY IT UP JUST LIKE IT IS.	CARRY THE DRAWERS UP FIRST.

9

	A	B	C
	GET A HIGHER CHAIR.	PLACE A PIECE OF FOLDED PAPER UNDER ONE LEG.	PRESS DOWN HARDER WITH HER PENCIL.
2	PUT A PIECE OF CARDBOARD OVER THE WINDOW PANE.	PUT THE CHAIR IN FRONT OF THE WINDOW.	BUILD A FIRE IN THE FIREPLACE.
3	CHECK HER WORK.	WRITE A LETTER TO A FRIEND.	COPY HER ANSWERS ON ANOTHER PIECE OF PAPER.

SCRIPT - PICTURE-BOOK FORM

Hello, boys and girls. We are going to do something today we think you will enjoy. We are going to show you some pictures we have drawn. When we show you the pictures we want you to study them closely, because we are going to ask you questions about the pictures.

We will now give everyone an answer booklet. When you get your booklet, do not open it. Put your full name on the first line and your grade on the second line. If you have any trouble, raise your hand and we will help you. (Pause 15 sec) We will do the first one together an an example. Look at the picture on the page. What might happen if the girls keep pulling on the doll ?

A. They will take turns playing with it.

B. One of the girls will win.

C. The doll may rip.

I want you to put an X in the box that tells what will happen if the girls keep pulling on the doll. Go ahead and mark your X.

(Pause 7 sec)

I am going to tell you the right answer this time. "C" is correct. The doll may rip.

Now, turn to page 2. You can do the rest on your own. I will not tell you the answers each time. What do you think is the problem is in this picture?

A. The boy's dog is lost.
B. The boy broke the dog's rope.
C. The boy thinks his dog has run away.

Mark an X in the box that tells what the problem is. (Pause 7 sec) Now turn to page 3.

What is the problem here?

A. The boy sees something that frightens him.
B. The boy is afraid it will rain.
C. The boy is afraid his tent will fall down.

(Pause 7 sec)

Now turn to page 4. Now I am going to ask you to do something different. I want you to pick the best question to ask to help figure out what is going on in the picture.

Put an "X" in the box you think has the best question to ask.

A. Were the 3 boys mean to the small boy?
B. Are the books interesting?
C. Can they get a drink?

(Pause 5 sec)

Now turn to page 5. Here is another picture. What is the best question to ask?

A. Why is the house so large?
B. Why is the girl running toward the boys?
C. Is the small boy her brother?

(Pause 5 sec)

Now turn to page 6. Look at this picture. Now, I want you to figure out the causes of the problem. These 2 cars just had a smashup. What do you think is the best guess of the cause of the accident? Look at the boxes next to number 1.

A. The black car slid on ice.

B. The white car was going too fast.

C. The sun was too bright.

(Pause 5 sec)

Number 2. Which one of these three is the best guess of the cause of the accident?

A. The sun blinded the driver of the black car.

B. The stop sign was too small to see.

C. The black car was driving too fast to stop.

(Pause 5 sec)

Now turn to page 7. Here is a new picture. These kids are on a committee. The committee must give a report about the Indian Geronimo. Which of these three questions should they ask to be sure they know what to do?

A. Will we still get recess after the report?

B. Did Geronomo kill General Custer?

C. How long should the report be?

(Pause 5 sec)

Now turn to page 8. Look at the top picture. Listen carefully.

These kids have to plan a party for Halloween. Their problem is that they need quite a bit of money; they need their teacher's permission; and the party must be held on a day when there are no other big events. They find out that they have the money and October 29th is a good day. Do they have enough information to go ahead planning the party? Mark "Yes" if you think they do; "No" if you think they do not; or you can mark "Don't know" if you don't know if they have enough information.

(Pause 7 sec)

Number 2. Look at the second picture. This boy wants to build a model airplane. He knows that he needs a razor blade, glue, blue and yellow paint, and a ruler. He gets a razor blade from his father, a ruler from his desk, and glue from the basement. Does he have everything he needs?

(Pause 7 sec)

Now turn to page 9. Here is the next picture. A boy is going to put some books on the shelves. What should he be sure to notice or think about? Look at the boxes next to number 1.

A. How many books are on the shelves?

B. Who put the bookcase where it is?

C. Where will he set the books when he gets the shelves?

(Pause 5 sec)

Number 2. Here are three things the boy could do. Which would be the best thing for him to do first?

A. Ask the boy who is sitting at the table to help.

B. Put the books in the box.

C. Place the books on top of the bookshelf.

(Pause 5 sec)

Number 3. Here are three more things the boy could do. Which would be best for him to do first?

A. Set the books on the table.

B. Push the table over by the shelf.

C. Kick the box out of the way.

(Pause 5 sec)

Now turn to page 10. Here is the next picture. This boy went down to the basement to play. He decided to make a playtown out of some things he found there. He wanted to pretend that the town was real and that a flying saucer had landed in it. He imagined that the police ran out of the police station to see what had landed. What thing could he use for a jail cell? Look at the boxes next to number 1.

A. A room in the dollhouse.

B. An old padlock.

C. The bird cage

(Pause 5 sec)

Number 2. What thing could he use for the sun?

A. The window.

B. The lamp.

C. An old record.

(Pause 5 sec)

Now turn to page 11. Here is the next picture. This ball is caught on the roof. Now look at the three choices in your answer book. What is the most unusual way for these children to get the ball down? By unusual we mean a way most people would not think of.

Is it picture A?
Picture B? or
Picture C?

(Pause 5 sec)

Now turn to page 12. This girl has hung some laundry out to dry, but she has used up all the space on the line and still has some laundry left over. What is the most unusual way she can dry the left-over laundry?

A?
B? or
C?

(Pause 5 sec)

Now turn to page 13. These children's swing has broken. They now have no place to swing. What is the most unusual way they can fix it so they can swing?

A?
B? or
C?

(Pause 5 sec)

Now turn to page 14. This girl is going to hang a picture in her room. But she has the hook very close to the edge of the frame. What will happen if the girl hangs the picture on the wall?

A?

B? or

C?

(Pause 5 sec)

Now turn to page 15. This girl is going to mix some of the red and white paint together. What will happen?

A. She will get a pink color.

B. She will spill all of it.

C. The paint will dry up.

(Pause 5 sec)

Now turn to page 16. What might happen if you piled some more boxes on the second shelf?

A. The cabinet might fall over.

B. The shelf might break under the load.

C. The boxes might not fit.

(Pause 5 sec)

Now turn to page 17. Here is the next picture. This girl's room is very crowded. If you wanted more room to store things, where would you put them?

A. Out in the hallway.

B. In boxes under the bed.

C. In somebody else's room.

(Pause 5 sec)

Now turn to page 18. These boys have to move the dresser upstairs. How would you do it?

A. Empty out the drawers.

B. Carry it up just like it is.

C. Carry the drawers up first.

(Pause 5 sec)

Now turn to page 19. This girl's school desk is wobbling. What could she do to make it steadier?

A. Get a higher chair.

B. Place a piece of folded paper under one leg.

C. Press down harder with her pencil.

(Pause 5 sec)

Now turn to page 20. In this picture a window pane is broken. What could the boy do to stop the cold air from coming in the broken window?

A. Put a piece of cardboard over the window pane.

B. Put a chair in front of the window.

C. Build a fire in the fireplace.

(Pause 5 sec)

Now turn to page 21. This girl is finishing a test in school. Before handing it in to the teacher, what should she do?

A. Check her work.

B. Write a letter to a friend.

C. Copy her answers on another piece of paper.

Now, close your books and make sure your name is on the first page. We will come to your desk and collect your books.

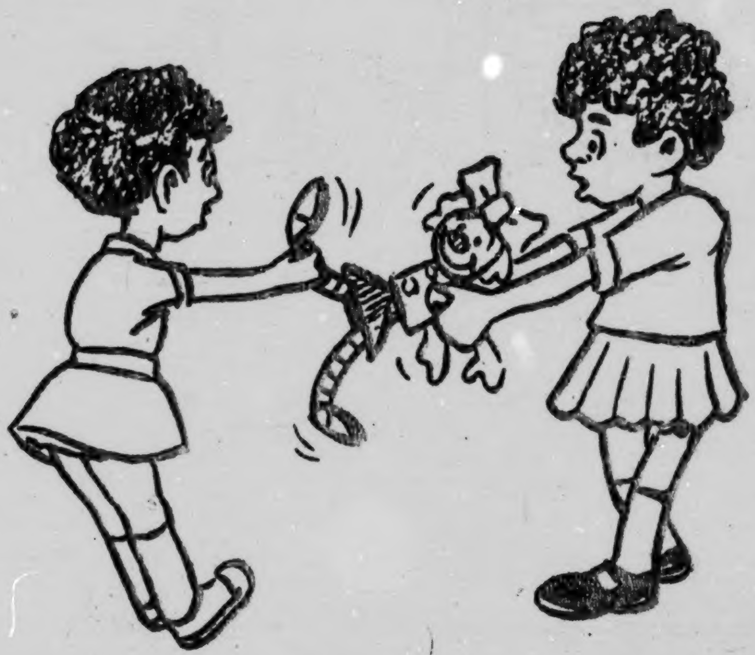
NAME ____________________

GRADE ____________________

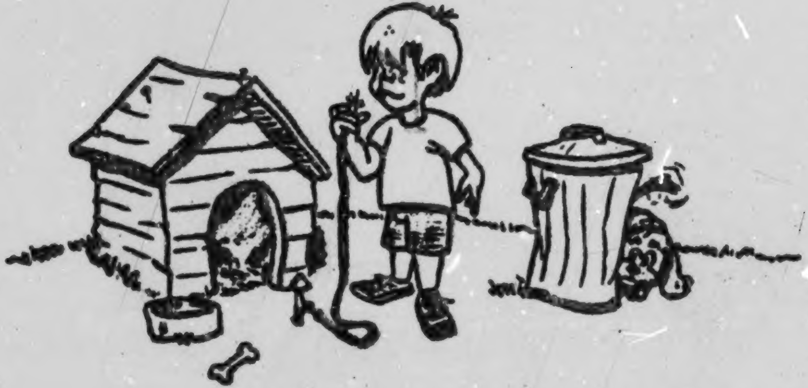
BOY ______ GIRL ______

(Pictures)

EXAMPLE



A	B	C
THEY WILL TAKE TURNS PLAYING WITH IT.	ONE OF THE GIRLS WILL WIN.	THE DOLL MAY RIP.



A

THE BOY'S DOG IS LOST.

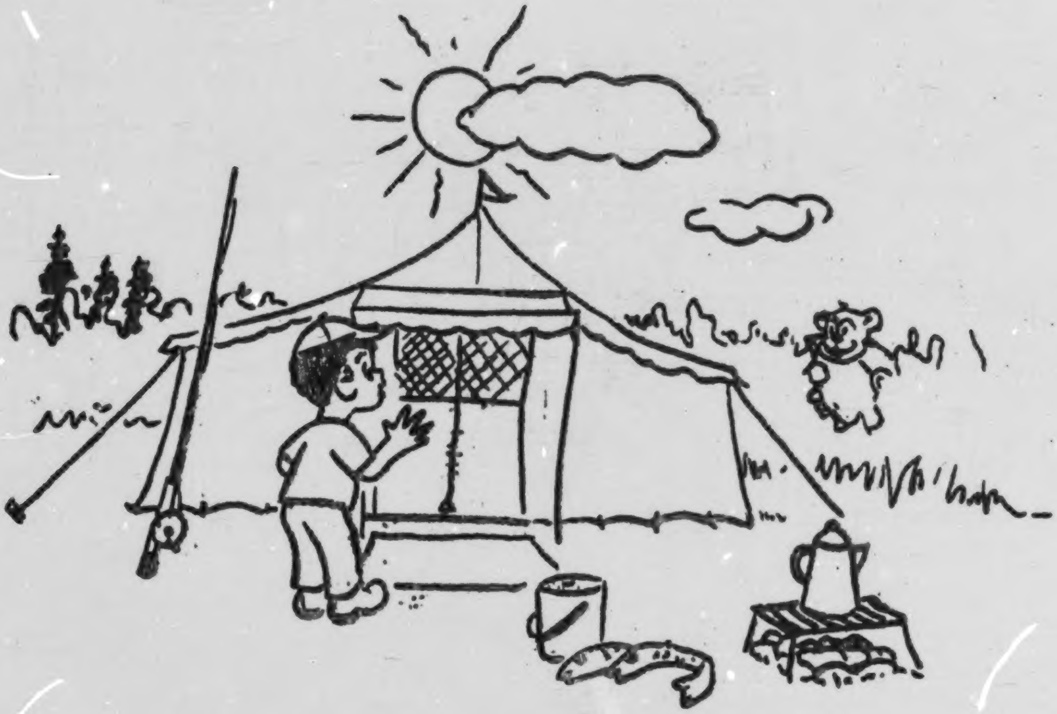
B

THE BOY BROKE THE DOG'S ROPE.

C

THE BOY THINKS HIS DOG HAS RUN AWAY.

2



A

THE BOY SEES SOMETHING THAT FRIGHTENS HIM.

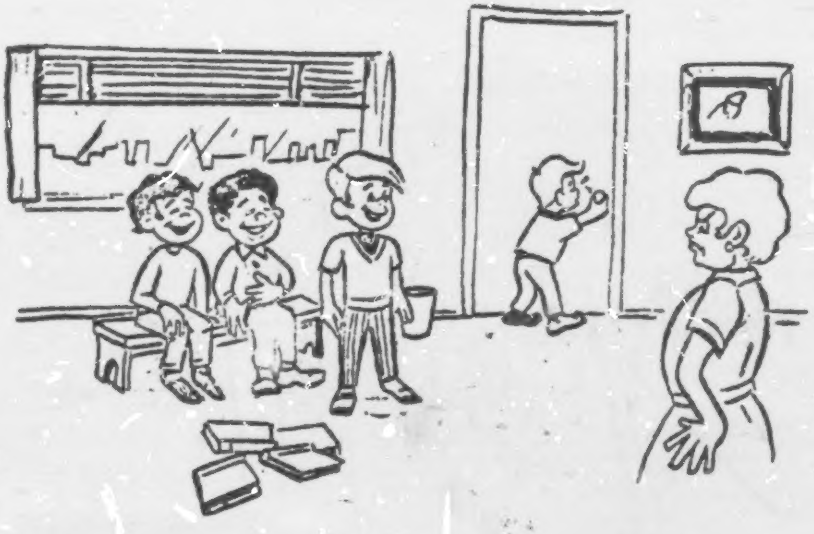
B

THE BOY IS AFRAID IT WILL RAIN.

C

THE BOY IS AFRAID HIS TENT WILL FALL DOWN.

3



A

WERE THE 3 BOYS MEAN TO THE SMALL BOY?

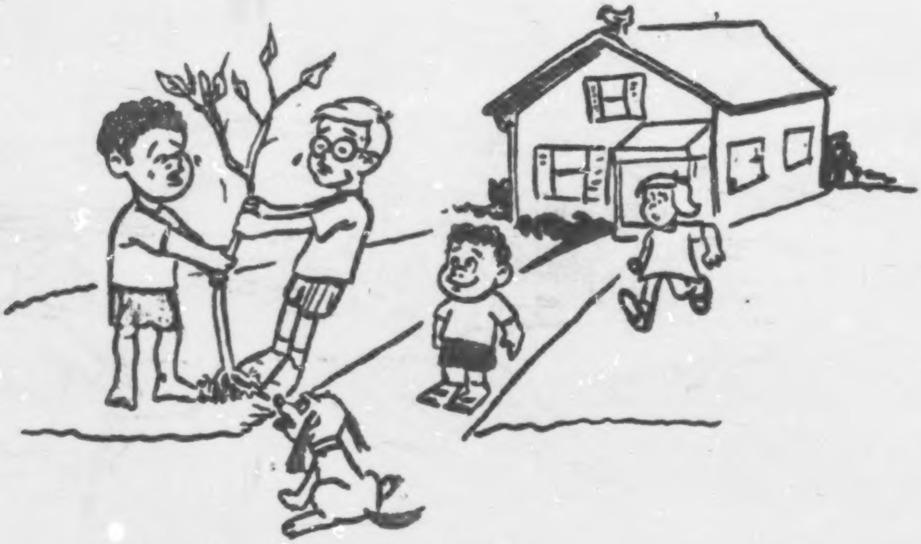
B

ARE THE BOOKS INTERESTING?

C

CAN THEY GET A DRINK?

4



____ ____ ____ ________ ____

A

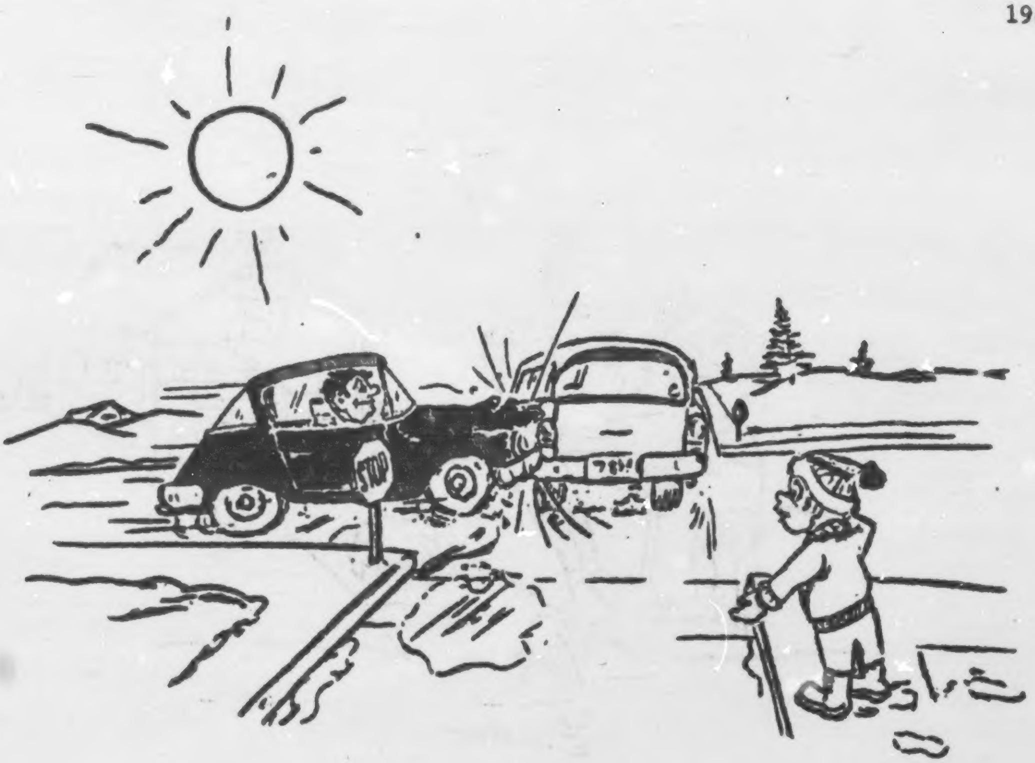
WHY IS THE HOUSE SO LARGE?

B

WHY IS THE GIRL RUNNING TOWARD THE BOYS?

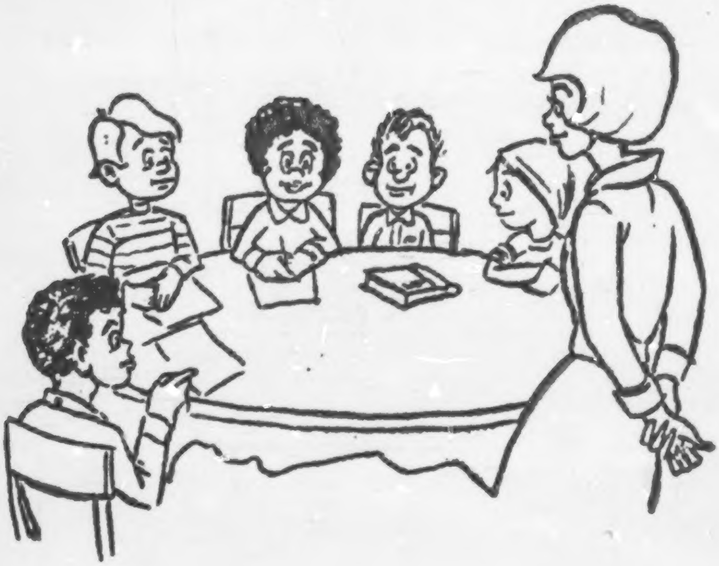
C

IS THE SMALL BOY HER BROTHER?



	A	B	C
1	THE BLACK CAR SLID ON ICE.	THE WHITE CAR WAS GOING TOO FAST.	THE SUN WAS TOO BRIGHT.
2	THE SUN BLINDED THE DRIVER OF THE BLACK CAR.	THE STOP SIGN WAS TOO SMALL TO SEE.	THE BLACK CAR WAS DRIVING TOO FAST TO STOP.

6



A

WILL WE STILL
GET RECESS AFTER
THE REPORT?

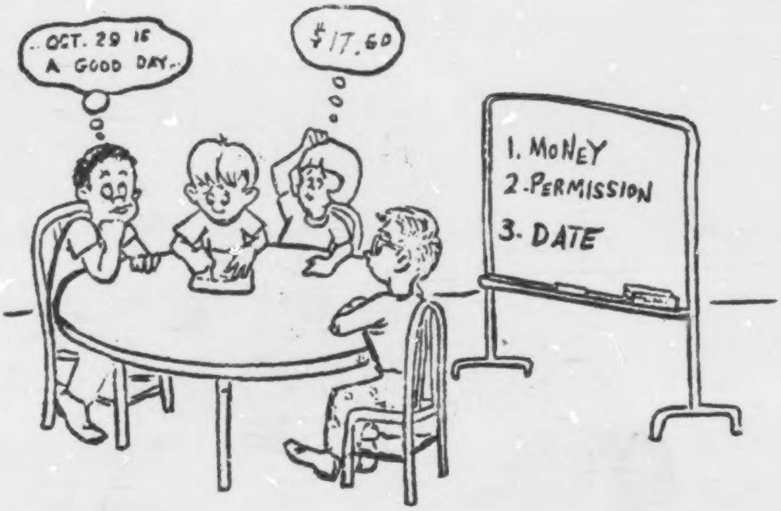
B

DID GERONIMO KILL
GENERAL CUSTER?

C

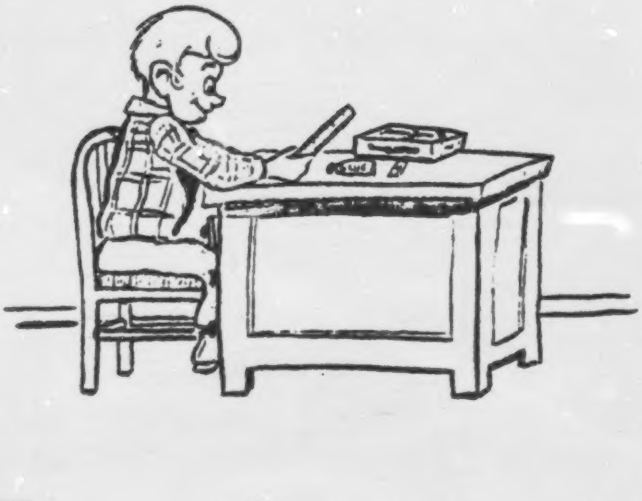
HOW LONG SHOULD
THE REPORT BE?

7


OCT. 29 IS A GOOD DAY..
$17.60
1. MONEY
2. PERMISSION
3. DATE

1

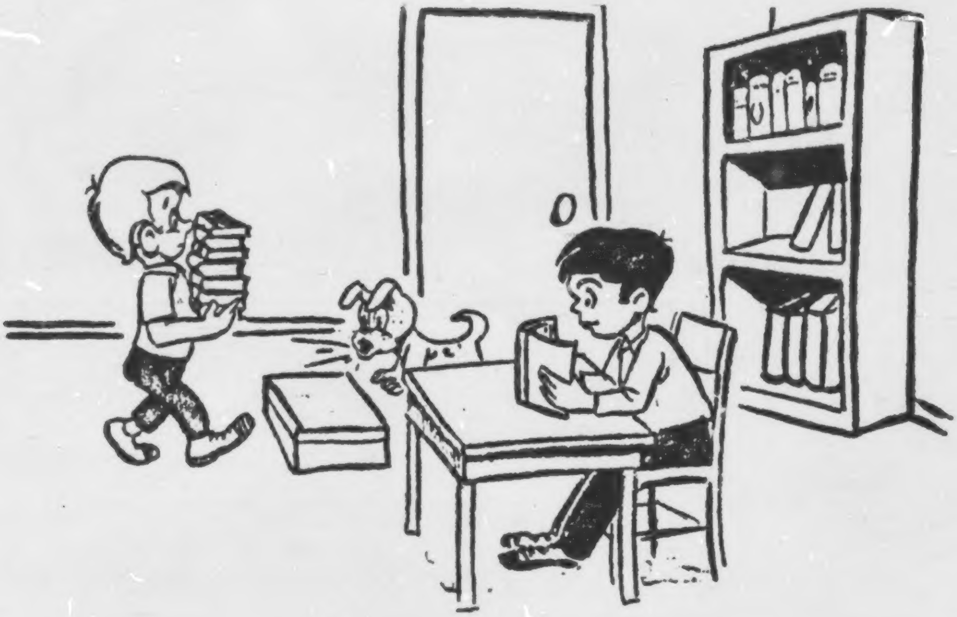
☐ YES	☐ NO	☐ I DON'T KNOW



2

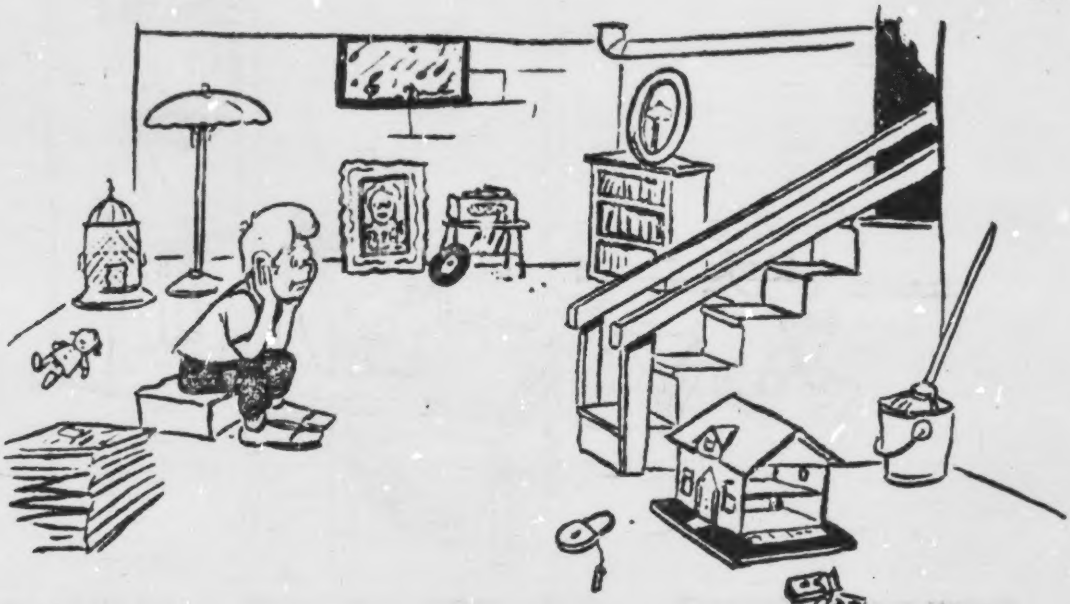
☐ YES	☐ NO	☐ I DON'T KNOW

8



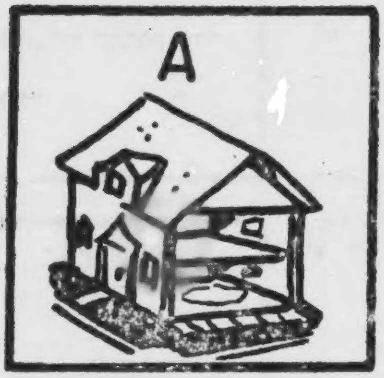
	A	B	C
1	HOW MANY BOOKS ARE ON THE SHELVES?	WHO PUT THE BOOKCASE WHERE IT IS?	WHERE WILL HE SET THE BOOKS WHEN HE GETS TO THE SHELF?
2	ASK THE BOY WHO IS SITTING AT THE TABLE TO HELP.	PUT THE BOOKS IN THE BOX.	PLACE THE BOOKS ON TOP OF THE BOOKSHELF.
3	SET THE BOOKS ON THE TABLE.	PUSH THE TABLE OVER BY THE SHELF.	KICK THE BOX OUT OF THE WAY.

9



1

A



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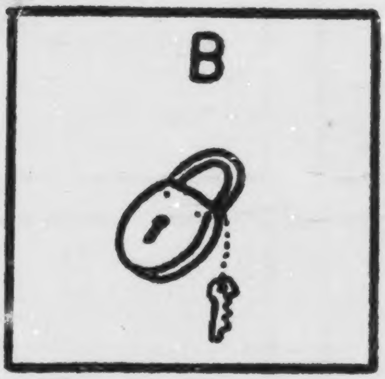

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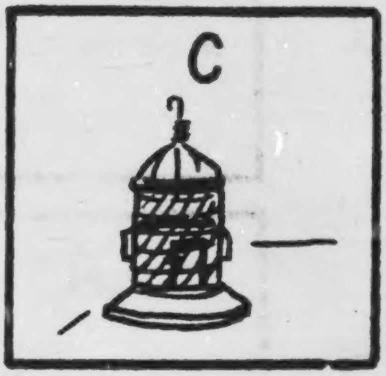
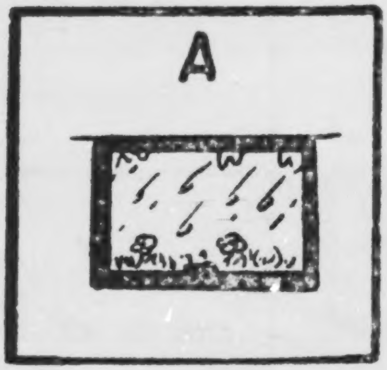


2

A



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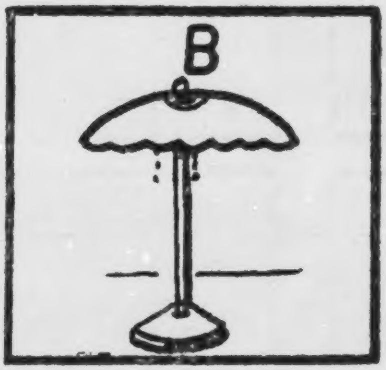

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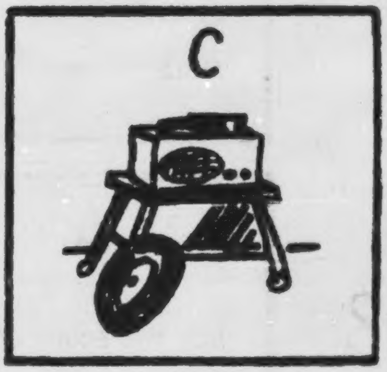

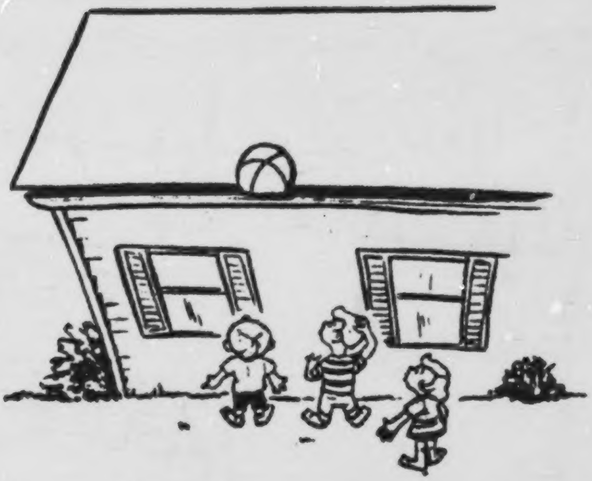

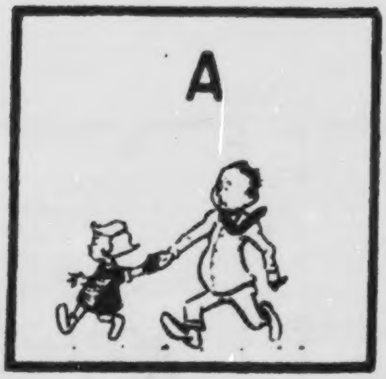

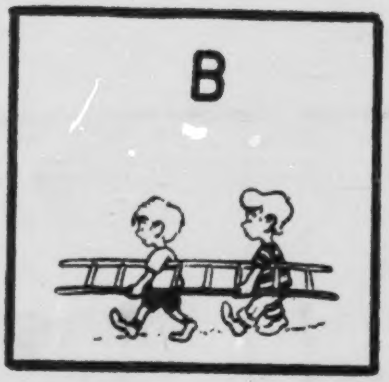

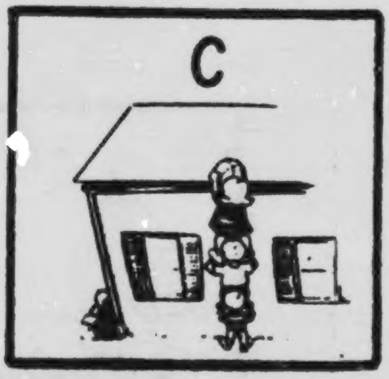

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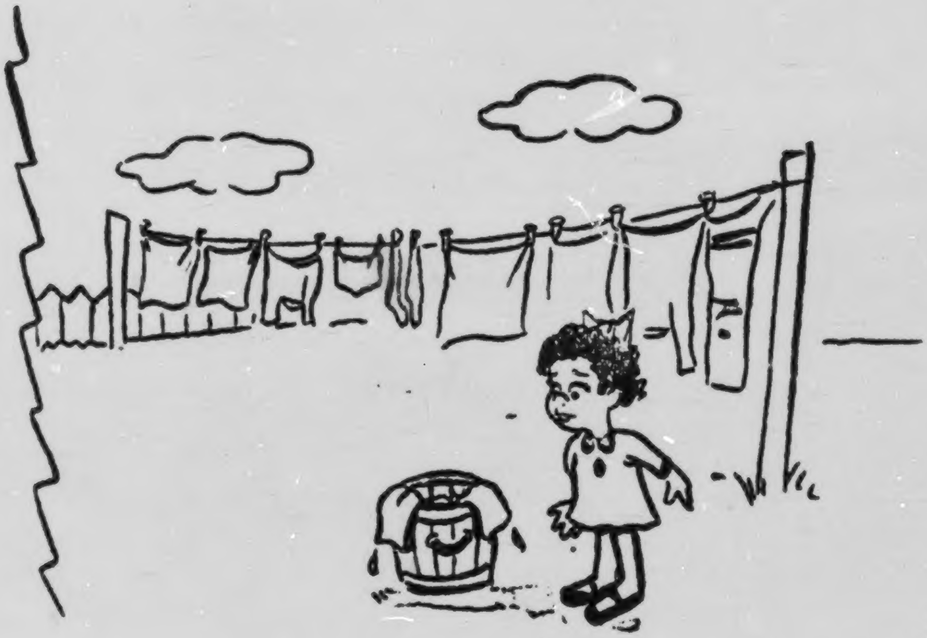

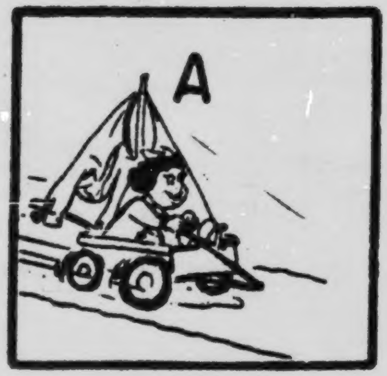
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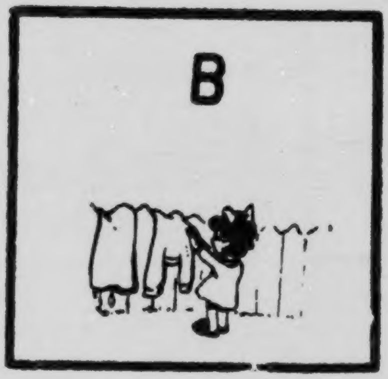
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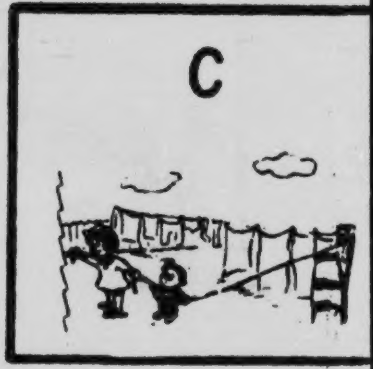
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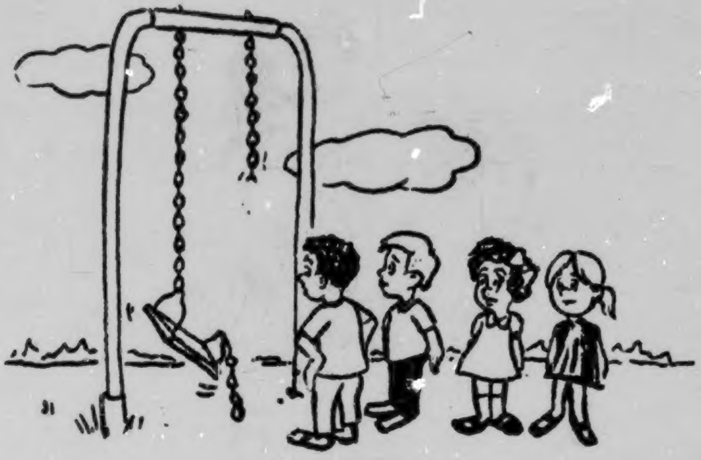

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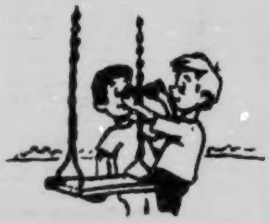

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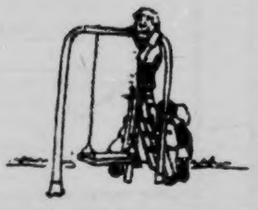
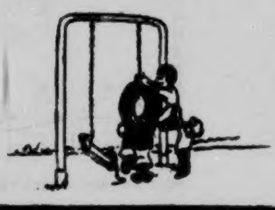
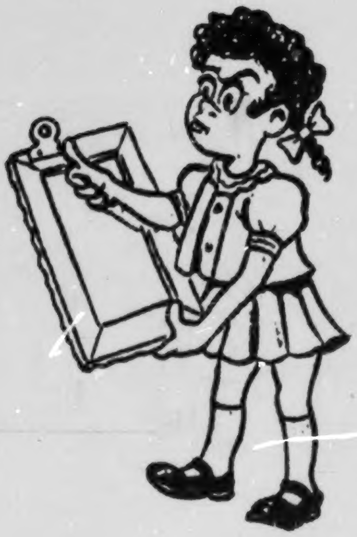
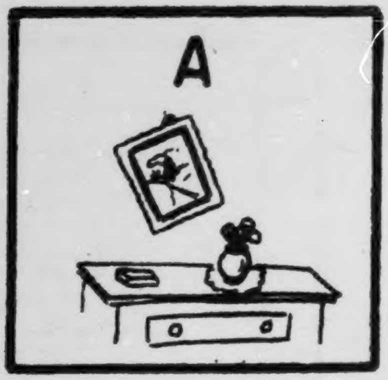
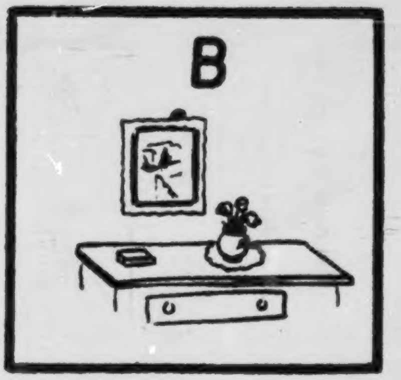


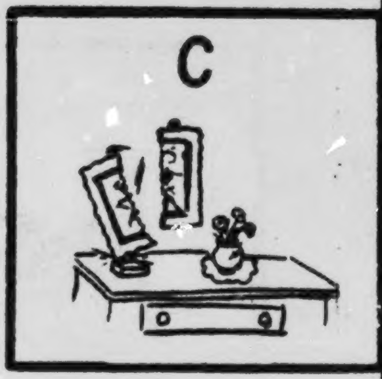
C











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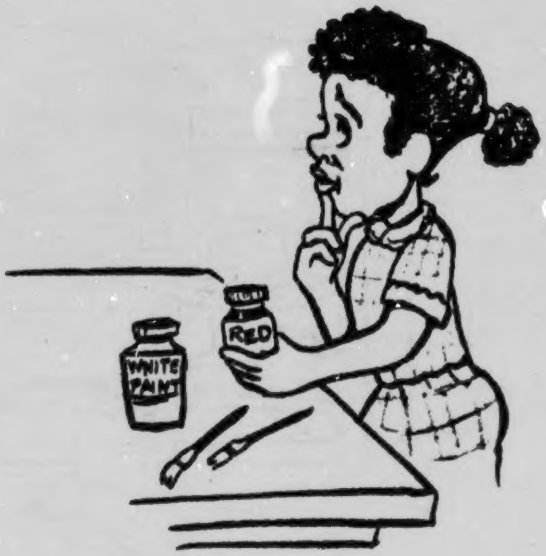

WHITE PAINT
RED

A

SHE WILL GET A PINK COLOR.

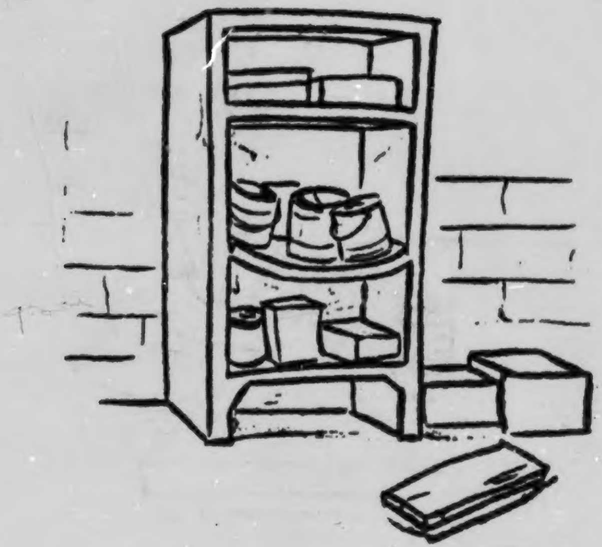
B

SHE WILL SPILL ALL OF IT.

C

THE PAINT WILL DRY UP.

15



A

THE CABINET MIGHT FALL OVER.

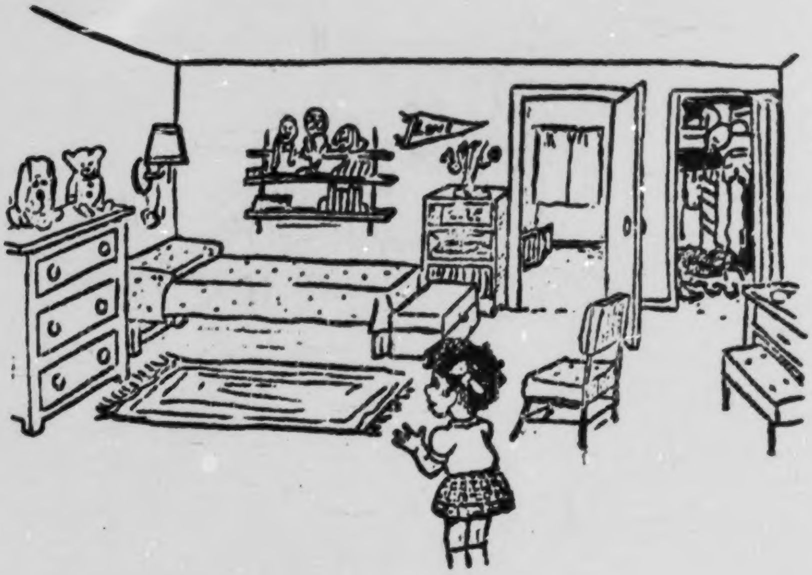
B

THE SHELF MIGHT BREAK UNDER THE LOAD.

C

THE BOXES MIGHT NOT FIT.

16



A

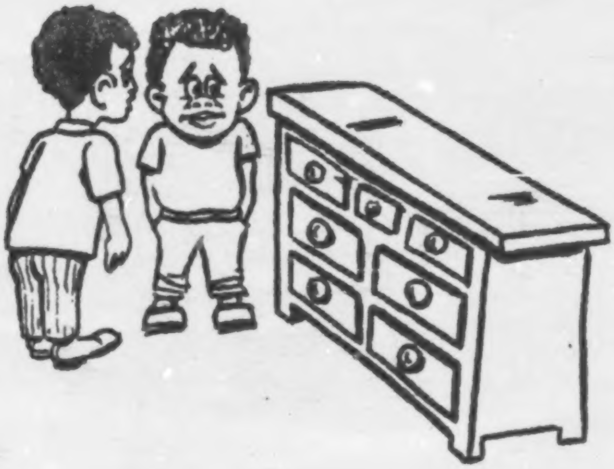
OUT IN THE HALLWAY.

B

IN BOXES UNDER THE BED.

C

IN SOMEBODY ELSE'S ROOM.



A

EMPTY OUT THE DRAWERS.

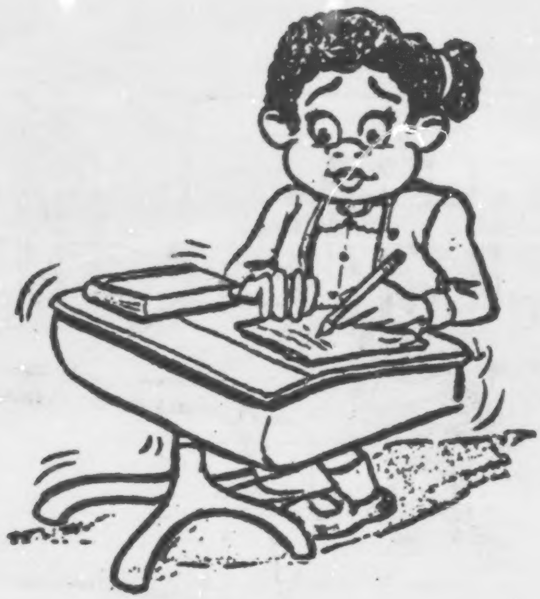
B

CARRY IT UP JUST LIKE IT IS.

C

CARRY THE DRAWERS UP FIRST.

18



A

GET A HIGHER CHAIR.

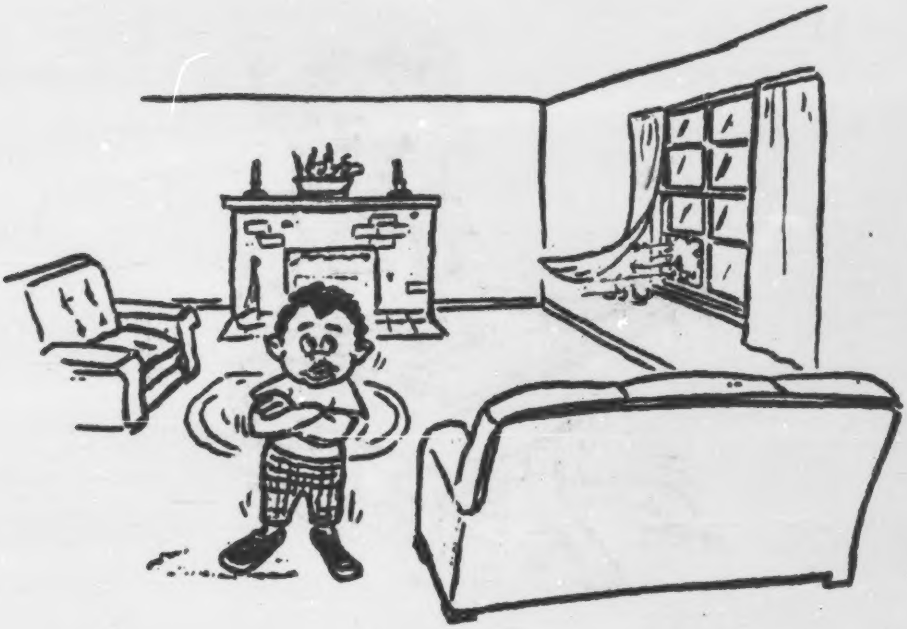
B

PLACE A PIECE OF
FOLDED PAPER UNDER
ONE LEG.

C

PRESS DOWN HARDER
WITH HER PENCIL.

19



A

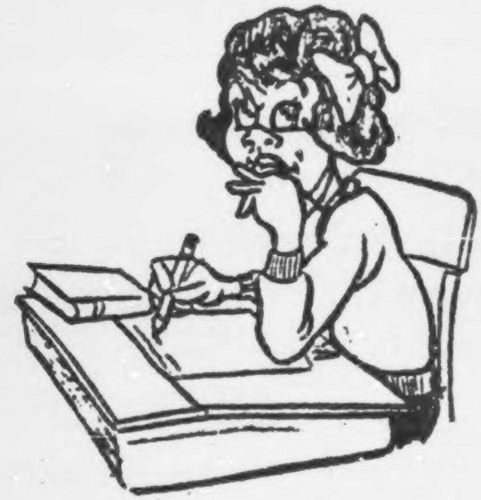
PUT A PIECE OF CARDBOARD OVER THE WINDOW PANE.

B

PUT THE CHAIR IN FRONT OF THE WINDOW.

C

BUILD A FIRE IN THE FIREPLACE.



A

CHECK HER WORK.

B

WRITE A LETTER TO A FRIEND.

C

COPY HER ANSWERS ON ANOTHER PIECE OF PAPER.

SCRIPT - ABSTRACT FORM

Hello, boys and girls. We are going to do something today we think you will enjoy. We have written some stories that we will read to you. When we read the stories, we want you to listen carefully, because we will ask you some questions about the stories.

We will now give everyone an answer booklet. When you get your book, do not open it. Print your full name on the first line and your grade on the second line. If you have any trouble, raise your hand and we will help you. (Pause 15 sec.) OK, open your books to page one. We will do the first one together as an example.

Read the story on this page to yourself. After you have read the story, look for the row of boxes under the story. There are three boxes under the story. Read the story and the three choices. Then put a big X in the box that tells the correct answer to the question.

Two girls both want to play with the same doll. One girl is pulling the doll's legs and the other girl is pulling the doll by the arms. What might happen if the two girls keep pulling the doll?

A. They will take turns playing with it.

B. One of the girls will win.

C. The doll may rip.

Mark the right answer to the question with an X. Make your X fill the whole box. Make sure the lines are dark enough to see. (Pause 7 sec). This time I'm going to tell you the right answer. C is the right answer. If the girls keep pulling on the doll, the doll may rip.

Now I want you to try some on your own. I will not tell you the answers each time. Read each story, read the answers in the boxes below each story, and mark the right answer in your booklet by putting a big X in the right box.

Now turn to Page 2.

A young boy is standing near an empty doghouse. He looks worried. He is looking at his dog's broken rope that is attached to a stake close by. The dog is hiding behind a garbage can. The boy does not see the dog. What is the problem here?

A. The boy's dog is lost.

B. The boy broke the dog's rope.

C. The boy thinks his dog has run away.

(Pause 7 sec.)

A young boy is standing in front of a tent. He looks scared. A large bear is coming toward the tent through the bushes. The boy has been fishing and his fishing pole is leaning against the side of the tent. A coffee pot is on a grill and two fish are lying beside it. A cloud hides the sun. What is the main problem here?

A. The boy sees something that frightens him.

B. The boy is afraid it will rain.

C. The boy is afraid his tent will fall down.

(Pause 7 sec) Now turn to page 3.

Two boys are sitting on a bench in a corner of their classroom. A third boy is standing near the bench. All three boys are laughing. A fourth boy is leaving the room. He is crying. The teacher looks angry. Four books are in a pile on the floor near the laughing boys. Which question would be the best one for you to ask if you wanted to find out what the problem is?

A. Were the 3 boys mean to the small boy?

B. Are the books interesting?

C. Can they get a drink?

(Pause 7 sec)

A small boy and a barking dog are watching two big boys. The two big boys are pulling a tiny tree. A girl is running towards the boys from a house close by. Which question would be the best one for you to ask if you wanted to find out what was happening?

A. Why is the house so large?

B. Why is the girl running towards the boys?

C. Is the small boy her brother?

(Pause 5 sec) Now turn to page 4.

Read the story at the top of this page and answer the two questions about it.

The sun is shining, but the roads are icy. A boy sees a black car go through a stop sign and hit the side of a white car. Why did the accident happen?

A. The black car slid on ice.

B. The white car was going too fast.

C. The sun was too bright.

(Pause 5 sec)

Here is another question about the car crash.

Why didn't the black car stop at the stop sign?

A. The sun blinded the driver of the black car.

B. The stop sign was too small to see.

C. The black car was driving too fast to stop.

(Pause 5 sec) Go on to page 5.

Five children are sitting around a table. The teacher is standing in front of them. She has asked them to prepare a report about an Indian named Geronomo. Now she will answer any questions the children have. What should you ask if you had to do this report?

A. Will we still get recess after the report?

B. Did Geronimo kill General Custer?

C. How long should the report be?

(Pause 5 sec) Now turn to page 6.

A party is being planned by four children. They are seated around a table in front of a blackboard. There are three words written on the blackboard: 1. money, 2. permission, and 3. date. The children must have this information before the party plans are complete. They talk about it for awhile. Then they decide that they have $17.50 to spend and are considering October 29 as the date for the party. Do the children have information to complete their plans?

A. Yes

B. No

C. Don't know

(Pause 5 sec)

A boy wished to build a model airplane. In order to do this, he needs a razor blade, a ruler, blue and yellow paint and some glue. He has a razor blade, a ruler, and some glue. Does the boy have everything he needs?

A. Yes

B. No

C. Don't know

(Pause 5 sec) Turn to page 7.

Read the story at the top of the page and answer the three questions about the story.

Two boys and a barking dog are in a room. One boy is carrying a stack of books from one side of the room to put into a bookcase on the other side of the room. There are three shelves in the bookcase, but no one shelf is high enough for all the books. The bookcase is almost as high as the ceiling. There is a box on the floor in the middle of the room. The second boy is reading at a table in a corner close by. What should the boy think about before he gets to the bookcase? Pick the most important from these three.

A. How many books are on the shelves?

B. Who put the bookcase where it is?

C. Where will he set the books when he gets to the shelf?

(Pause 5 sec) Here is another question about the boy and the books.

Which of the following should the boy carrying the books do while he is making room for the books in the bookcase?

A. Ask the boy who is sitting in the corner to help.

B. Put the books in the box.

C. Place the books on top of the bookshelf.

(Pause 5 sec) Go on to page 8.

Here is question number three about the boy and the books.

What should the boy carrying the books do first if he had a choice of these three?

A. Set the books on the table.

B. Push the table over by the shelf.

C. Kick the box out of the way.

(Pause 5 sec) Now turn to page 9.

The stories on this page are about a boy who wants to build a play town in his basement. Read each story and mark an X on the right answer to the question.

A young boy is sitting in his basement alone. He wants to build a play town which has a jail. A padlock with a key is on the floor near the boy. Behind him is an empty wire bird cage. Near the stairs is a doll house with one side missing. Which of these three objects could the boy use for his jail?

A. Doll house.

B. Padlock with key.

C. Bird Cage.

(Pause 5 sec)

Here is another story about the boy and his play town.

The small boy is playing in his basement because it is raining. Raindrops can be seen through a window near the basement ceiling. The boy wants to have the sun in his play town. There is a lamp behind the boy and there is an old record player with several records near one corner of the room. What could the boy use for the sun?

A. Window

B. Lamp

C. Old record

(Pause 5 sec) Turn to page 10

Two boys and a girl are looking at a ball which had landed on a roof. They want to play with the ball. What is the most unusual or different way for them to get it? By unusual we mean a way that most people will not think of to solve the problem.

A. They can ask an older person to help them.

B. They can use a ladder to get the ball.

C. Each child can stand on the shoulders of another child until they are tall enough to reach the ball.

(Pause 5 sec)

Clothes are drying on a line. There are more wet clothes in the wash basket, but there is no more line space. A girl is standing by the basket wondering what to do. What is the most unusual or different way for the girl to dry the clothes from the basket?

A. She can tie the clothes on a pole like a sail on her wagon and go for a ride while they dry.

B. She can place the clothes over a nearby fence to dry.

C. She can have someone help her put up another clothes line.

(Pause 5 sec) Go on to page 11.

The chain on one side of a swing is broken into two pieces. Four children are looking at the damage. They wish to swing. What is the most unusual or different way for them to do this?

A. They can fix the old swing by tying the two pieces of the chain together with a string.

B. They can fix the old swing by replacing the broken chain with a new one.

C. They can make a new swing by tying one chain to a tire.

(Pause 5 sec) Now turn to page 12.

A girl wants to hang a picture in her room. She has a hook close to one corner of the picture. What will happen when the girl tries to hang her picture on a nail in the wall?

A. The picture will hang crooked.

B. The picture will hang straight.

C. The picture will crack and fall.

(Pause 5 sec) Turn to page 13.

A large jar of white paint and two paint brushes are on a table. A girl is holding a small jar of red paint. What will happen when the girl mixes the paints?

A. She will get a pink color.

B. She will spill all of it.

C. The paint will dry up.

(Pause 5 sec)

There is a cabinet with three shelves. There are boxes and other things on the shelves. More boxes are to be put in the cabinet. There is very little space on either the top or bottom shelf. Several heavy paint cans are on the middle shelf. This shelf is sagging. What might happen when more boxes are put into the middle shelf of the cabinet?

A. The cabinet might fall over.

B. The shelf might break under the load.

C. The boxes might not fit.

(Pause 5 sec) Go on to page 14.

A girl is looking around in her bedroom. The room is neat, but toys, books, clothes, and records fill all the shelves. She does not want to have a messy room. What is the best place for her to put her new things?

A. Out in the hallway.

B. In boxes under the bed.

C. In somebody else's room.

(Pause 5 sec)

A full chest of drawers has to be moved upstairs. Two boys stand looking at this. What is the easiest way for them to move it?

A. Empty out the drawers.

B. Carry it up just like it is.

C. Carry the drawers up first.

(Pause 5 sec) Now turn to page 15.

A student is sitting at a low desk. She is having difficulty writing because the desk is wobbling. What should she do?

A. Get a higher chair.

B. Place a piece of folded paper under one leg.

C. Press down harder with her pencil.

(Pause 5 sec)

A sofa, an armchair, a rug, and a fireplace are in a living room. There is no fire in the fireplace. One of the windows is broken. A boy in the room is very cold. What should he do?

A. Put a piece of cardboard over the window pane.

B. Put the chair in front of the window.

C. Build a fire in the fireplace.

(Pause 5 sec) Turn to page 16.

A girl is sitting in a chair at a desk. She has just finished writing her answers for a test. What should the girl do now?

A. Check her work.

B. Write a letter to a friend.

C. Copy her answers on another piece of paper.

(Pause 5 sec).

NAME ______________________

GRADE ______________________

BOY ________ GIRL ________

READ THE STORY ON THIS PAGE TO YOURSELF. AFTER YOU HAVE READ THE STORY, LOOK FOR THE ROW OF BOXES UNDER THE STORY. THERE ARE THREE BOXES UNDER THE STORY. READ THE STORY AND THE THREE CHOICES. THEN PUT A BIG X IN THE BOX THAT TELLS THE CORRECT ANSWER TO THE QUESTION.

Two girls both want to play with the same doll. One girl is pulling the doll's legs and the other girl is pulling the doll by the arms. What might happen if the two girls keep pulling the doll?

A	B	C
THEY WILL TAKE TURNS PLAYING WITH IT.	ONE OF THE GIRLS WILL WIN.	THE DOLL MAY RIP.

MARK THE RIGHT ANSWER TO THE QUESTION WITH AN X. MAKE YOUR X FILL THE WHOLE BOX. MAKE SURE THE LINES ARE DARK ENOUGH TO SEE. THIS TIME I'M GOING TO TELL YOU THE RIGHT ANSWER. C IS THE RIGHT ANSWER. IF THE GIRLS KEEP PULLING ON THE DOLL, THE DOLL MAY RIP.

NOW I WANT YOU TO TRY SOME ON YOUR OWN. I WILL NOT TELL YOU THE ANSWERS EACH TIME. READ EACH STORY, READ THE ANSWERS IN THE BOXES BELOW EACH STORY, AND MARK THE RIGHT ANSWER IN YOUR BOOKLET BY PUTTING A BIG X IN THE RIGHT BOX.

NOW TURN TO PAGE 2

A young boy is standing near an empty doghouse. He looks worried. He is looking at his dog's broken rope that is attached to a stake close by. The dog is hiding behind a garbage can. The boys does not see the dog. What is the problem here?

A

THE BOY'S DOG IS LOST.

B

THE BOY BROKE THE DOG'S ROPE.

C

THE BOY THINKS HIS DOG HAS RUN AWAY.

A young boy is standing in front of a tent. He looks scared. A large bear is coming toward the tent through the bushes. The boy has been fishing and his fishing pole is leaning against the side of the tent. A coffee pot is on a grill and two fish are lying beside it. A cloud hides the sun. What is the main problem here?

A

THE BOY SEES SOMETHING THAT FRIGHTENS HIM.

B

THE BOY IS AFRAID IT WILL RAIN.

C

THE BOY IS AFRAID HIS TENT WILL FALL DOWN.

NOW TURN TO PAGE 3

Two boys are sitting on a bench in a corner of their classroom. A third boy is standing near the bench. All three boys are laughing. A fourth boy is leaving the room. He is crying. The teacher looks angry. Four books are in a pile on the floor near the laughing boys. Which question would be the best one for you to ask if you wanted to find out what the problem is?

A

WERE THE 3 BOYS MEAN TO THE SMALL BOY?

B

ARE THE BOOKS INTERESTING?

C

CAN THEY GET A DRINK?

A small boy and a barking dog are watching two big boys. The two big boys are pulling a tiny tree. A girl is running toward the boys from a house close by. Which question would be the best one for you to ask if you wanted to find out what was happening?

A

WHY IS THE HOUSE SO LARGE?

B

WHY IS THE GIRL RUNNING TOWARD THE BOYS?

C

IS THE SMALL BOY HER BROTHER?

TURN TO PAGE 4

READ THE STORY AT THE TOP OF THIS PAGE AND ANSWER THE TWO QUESTIONS ABOUT IT.

The sun is shining, but the roads are icy. A boy sees a black car go through a stop sign and hit the side of a white car. Why did the accident happen?

A	B	C
THE BLACK CAR SLID ON ICE.	THE WHITE CAR WAS GOING TOO FAST.	THE SUN WAS TOO BRIGHT.

HERE IS ANOTHER QUESTION ABOUT THE CAR CRASH.

Why didn't the black car stop at the stop sign?

A	B	C
THE SUN BLINDED THE DRIVER OF THE BLACK CAR.	THE STOP SIGN WAS TOO SMALL TO SEE.	THE BLACK CAR WAS DRIVING TOO FAST TO STOP.

GO ON TO PAGE 5

Five children are sitting around a table. The teacher is standing in front of them. She has asked them to prepare a report about an Indian named Geronimo. Now she will answer any questions the children have. What should you ask if you had to do this report?

A	B	C
WILL WE STILL GET RECESS AFTER THE REPORT?	DID GERONIMO KILL GENERAL CUSTER?	HOW LONG SHOULD THE REPORT BE?

NOW TURN TO PAGE 6.

A party is being planned by four children. They are seated around a table in front of a blackboard. There are three words written on the blackboard: 1. money, 2. permission, and 3. date. The children must have this information before the party plans are complete. They talk about it for awhile. Then they decide that they have $17.50 to spend and are considering October 29 as the date for the party. Do the children have enough information to complete their plans?

YES	NO	DON'T KNOW

A boy wishes to build a model airplane. In order to do this, he needs a razor blade, a ruler, blue and yellow paint, and some glue. He has a razor blade, a ruler, and some glue. Does the boy have everything he needs?

YES	NO	DON'T KNOW

TURN TO PAGE 7

READ THE STORY AT THE TOP OF THE PAGE AND ANSWER THE THREE QUESTIONS ABOUT THE STORY.

Two boys and a barking dog are in a room. One boys is carrying a stack of books from one side of the room to put into a bookcase on the other side of the room. There are three shelves in the bookcase, but no one shelf is high enough for all the books. The bookcase is almost as high as the ceiling. There is a box on the floor in the middle of the room. The second boy is reading at a table in a corner close by. What should the boy think about before he gets to the bookcase? Pick the most important from these three.

A	B	C
HOW MANY BOOKS ARE ON THE SHELVES?	WHO PUT THE BOOKCASE WHERE IT IS?	WHERE WILL HE SET THE BOOKS WHEN HE GETS TO THE SHELF?

HERE IS ANOTHER QUESTION ABOUT THE BOY AND THE BOOKS.

Which of the following should the boy carrying the books do while he is making room for the books in the bookcase?

A	B	C
ASK THE BOY WHO IS SITTING IN THE CORNER TO HELP.	PUT THE BOOKS IN THE BOX.	PLACE THE BOOKS ON TOP OF THE BOOKSHELF.

GO ON TO PAGE 8

HERE IS QUESTION NUMBER THREE ABOUT THE BOY AND THE BOOKS.

What should the boy carrying the books do first if he had a choice of these three?

A

SET THE BOOKS ON THE TABLE.

B

PUSH THE TABLE OVER BY THE SHELF.

C

KICK THE BOX OUT OF THE WAY.

NOW TURN TO PAGE 9

THE STORIES ON THIS PAGE ARE ABOUT A BOY WHO WANTS TO BUILD A PLAY TOWN IN HIS BASEMENT. READ EACH STORY AND MARK AN X ON THE RIGHT ANSWER TO THE QUESTION.

A young boy is sitting in his basement alone. He wants to build a play town which has a jail. A padlock with a key is on the floor near the boy. Behind him is an empty wire bird cage. Near the stairs is a doll house with one side missing. Which of these three objects could the boy use for his jail?

A	B	C
DOLL HOUSE	PADLOCK WITH KEY	BIRD CAGE

HERE IS ANOTHER STORY ABOUT THE BOY AND HIS PLAY TOWN.

The small boy is playing in his basement because it is raining. Raindrops can be seen through a window near the basement ceiling. The boy wants to have the sun in his play town. There is a lamp behind the boy and there is an old record player with several records near one corner of the room. What could the boy use for the sun?

A	B	C
WINDOW	LAMP	OLD RECORD

TURN TO PAGE 1

Two boys and a girl are looking at a ball which has landed on a roof. They want to play with the ball. What is the most unusual or different way for them to get it? By unusual we mean a way that most people will not think of to solve the problem.

A	B	C
THEY CAN ASK AN OLDER PERSON TO HELP THEM.	THEY CAN USE A LADDER TO GET THE BALL.	EACH CHILD CAN STAND ON THE SHOULDERS OF ANOTHER CHILD UNTIL THEY ARE TALL ENOUGH TO REACH THE BALL.

Clothes are drying on a line. There are more wet clothes in the wash basket, but there is no more line space. A girl is standing by the basket wondering what to do. What is the most unusual or different way for the girl to dry the clothes from the basket?

A	B	C
SHE CAN TIE THE CLOTHES ON A POLE LIKE A SAIL ON HER WAGON AND GO FOR A RIDE WHILE THEY DRY.	SHE CAN PLACE THE CLOTHES OVER A NEARBY FENCE TO DRY.	SHE CAN HAVE SOMEONE HELP HER PUT UP ANOTHER CLOTHES LINE.

GO ON TO PAGE 11

The chain on one side of a swing is broken into two pieces. Four children are looking at the damage. They wish to swing. What is the most unusual or different way for them to do this?

A

THEY CAN FIX THE OLD SWING BY TYING THE TWO PIECES OF THE CHAIN TOGETHER WITH A STRING.

B

THEY CAN FIX THE OLD SWING BY REPLACING THE BROKEN CHAIN WITH A NEW ONE.

C

THEY CAN MAKE A NEW SWING BY TYING ONE CHAIN TO A TIRE.

NOW TURN TO PAGE 12

A girl wants to hang a picture in her room. She has put a hook close to one corner of the picture. What will happen when the girl tries to hang her picture on a nail in the wall?

A

THE PICTURE WILL HANG CROOKED.

B

THE PICTURE WILL HANG STRAIGHT.

C

THE PICTURE WILL CRACK AND FALL.

TURN TO PAGE 13

A large jar of white paint and two paint brushes are on a table. A girl is holding a small jar of red paint. What will happen when the girl mixes the paints?

A

SHE WILL GET A PINK COLOR.

B

SHE WILL SPILL ALL OF IT.

C

THE PAINT WILL DRY UP.

There is a cabinet with three shelves. There are boxes and other things on the shelves. More boxes are to be put in the cabinet. There is very little space on either the top or bottom shelf. Several heavy paint cans are on the middle shelf. This shelf is sagging. What might happen when more boxes are put into the middle shelf of the cabinet?

A

THE CABINET MIGHT FALL OVER.

B

THE SHELF MIGHT BREAK UNDER THE LOAD.

C

THE BOXES MIGHT NOT FIT.

GO ON TO PAGE 14

A girl is looking around in her bedroom. The room is neat, but toys, books, clothes, and records fill all the shelves. She does not want to have a messy room. What is the best place for her to put new things?

A

OUT IN THE HALLWAY.

B

IN BOXES UNDER THE BED.

C

IN SOMEBODY ELSE'S ROOM.

A full chest of drawers has to be moved upstairs. Two boys stand looking at this. What is the easiest way for them to move it?

A

EMPTY OUT THE DRAWERS.

B

CARRY IT UP JUST LIKE IT IS.

C

CARRY THE DRAWERS UP FIRST.

NOW TURN TO PAGE 15

A student is sitting at a low desk. She is having difficulty writing because the desk is wobbling. What should she do?

A	B	C
GET A HIGHER CHAIR.	PLACE A PIECE OF FOLDED PAPER UNDER ONE LEG.	PRESS DOWN HARDER WITH HER PENCIL.

A sofa, an armchair, a rug, and a fireplace are in a living room. There is no fire in the fireplace. One of the windows is broken. A boy in the room is very cold. What should he do?

A	B	C
PUT A PIECE OF CARDBOARD OVER THE WINDOW PANE.	PUT THE CHAIR IN FRONT OF THE WINDOW.	BUILD A FIRE IN THE FIREPLACE.

TURN TO PAGE 16

A girl is sitting in a chair at a desk. She has just finished writing her answers for a test. What should the girl do now?

A

CHECK HER WORK.

B

WRITE A LETTER TO A FRIEND.

C

COPY HER ANSWERS ON ANOTHER PIECE OF PAPER.